

# Chemical Engineering

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DECEMBER 1, 1958

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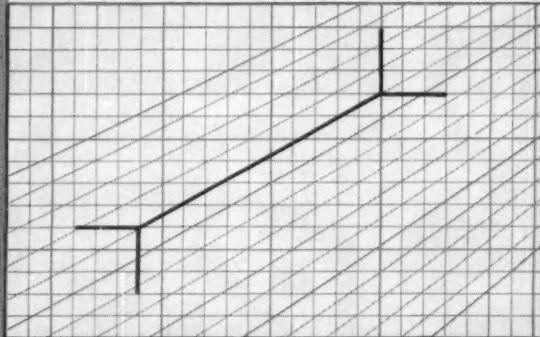
What's Right  
for  
Overtime?

Page 127



Check on Cooling  
Tower Performance

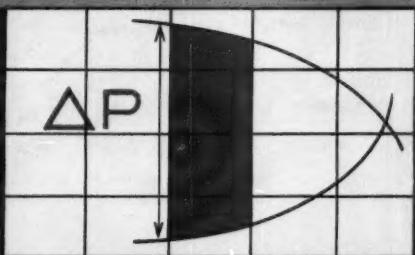
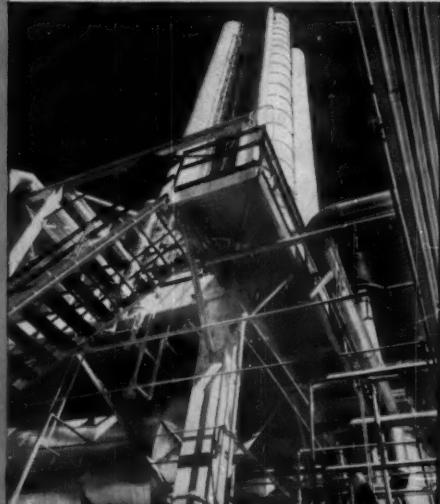
Page 111

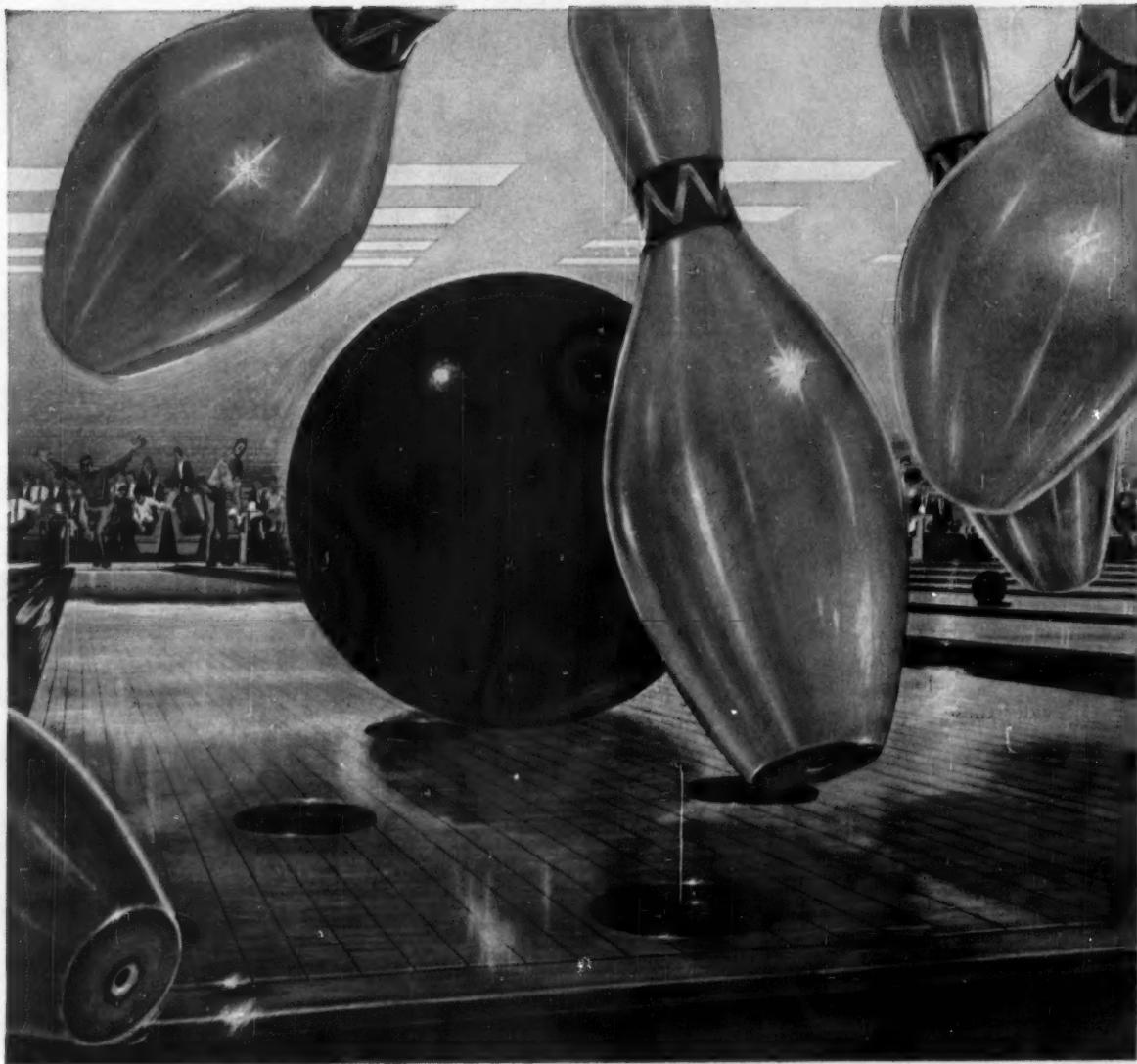


Get Full-Range Flow Control

Page 107

Polystyrene via  
"Natural"  
Ethyl Benzene  
Page 98





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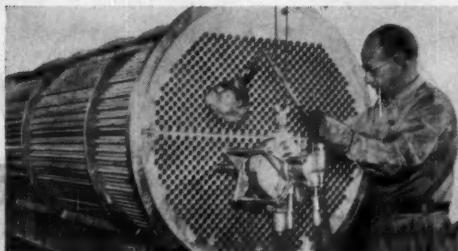
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## CONDENSER AND HEAT EXCHANGER CLINIC

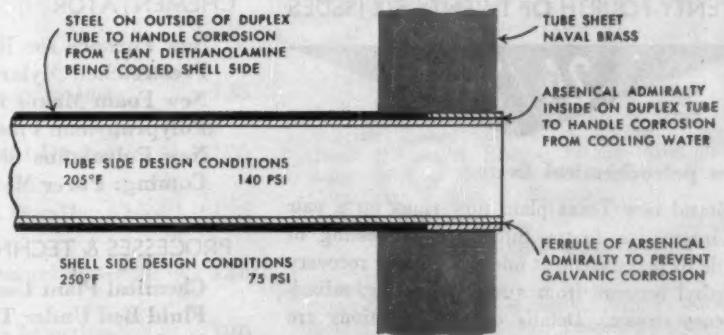
Edited by David S. Hibbard, Metallurgical Engineer  
The American Brass Company, Buffalo 5, N. Y.

### Duplex tube applications increase as corrosion and temperature-pressure problems grow more complex

New and improved processes in the chemical and petroleum industries—advancing design in power equipment both ashore and afloat, involving ever higher temperatures and pressures—are calling for more and more duplex tubes.

Working closely with both users and manufacturers of heat-exchange equipment, The American Brass Company is expanding its facilities to provide these special-purpose tubes in the combinations of metals and in the sizes and gages to meet new and growing needs.

**Dual corrosion problems.** Anaconda Duplex Tubes have been most often used to meet situations involving dual problems of corrosion. They are made by drawing tubes of copper or a copper alloy either inside or outside of steel tubes. However, they can be furnished in any combination of metals, including copper or copper alloys with other nonferrous metals or steel in a wide range of diameters and wall thicknesses.



**SKETCH SHOWING CONSTRUCTION** of Anaconda Duplex Tubes used in the cooler designed and built by Yuba. Tubes are  $\frac{3}{4}$ " O.D. x  $.065$ " wall x  $16\frac{1}{8}$ " long. The  $1\frac{1}{16}$ " thick tube sheets of Anaconda Naval Brass are  $31\frac{1}{2}$ " in diameter and  $35\frac{1}{2}$ " in diameter.

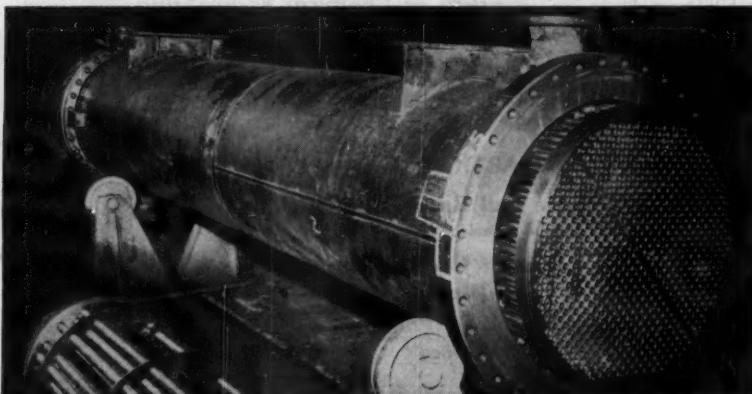
**For extra strength.** More and more Anaconda Duplex Tubes are being used in those applications where internal or external pressures—or the pressure-temperature combinations—are too great for a nonferrous tube alone. In this case the nonferrous tube is selected for the chemical properties required for the more corrosive fluid handled; and the

steel tube gives the needed strength.

**U-bends.** Duplex tubes can be readily bent to form the hairpin or U-bend tubes required for the compact U-bend tube design so advantageous in heat exchangers where wide temperature differences exist in the unit.

**Technical Assistance.** Specialists at the American Brass Company are constantly working with manufacturers and users of heat-exchange equipment, helping to solve process problems. This experience is available to you. For more detailed information on Duplex Tubes, U-bend Tubes, address: The American Brass Company, Buffalo Division, Buffalo 5, New York. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

887D



**A LEAN DIETHANOLAMINE COOLER** using Anaconda Duplex Tubes (see detail sketch above) designed and built by Yuba Heat Transfer Division of Yuba Consolidated Industries, Inc., Honesdale, Pa. This unit will cool Lean Diethanolamine at the new 19,000 barrels per stream day delayed coker designed, engineered and being constructed for Socony Mobil at Paulsboro, N. J. by The Lummus Company.

**ANACONDA®**  
TUBES and PLATES for  
CONDENSERS & HEAT EXCHANGERS  
Made by  
THE AMERICAN BRASS COMPANY

What's Right  
for  
Overtime?  
Page 127

Check on Cooling  
Tower Performance  
Page 111

Polystyrene via  
"Natural"  
Ethyl Benzene  
Page 98



TWENTY-FOURTH OF TWENTY-SIX ISSUES

24 / 26

**Two petrochemical firsts**

Brand new Texas plant now rings up a pair of impressive firsts: Integrated processing of crude to polystyrene at one site; Direct recovery of ethyl benzene from a narrow-boiling, mixed-xylenes stream. Details of the operations are diagrammed for you in this issue's process flowsheet. (p. 98)



**Three points to better flow control**

Here's a way, in your design calculations, to assure full range flow control. It's a simplified procedure for including system friction loss, pump discharge pressure and the important effect of control valve pressure drop. (p. 107)



**New way to check cooling towers**

Something never before available: a chart for really evaluating cooling towers. Three temperatures from one test can now be safely converted into a prediction of performance under any other set of conditions. And it's easy to get this information that's needed for efficient plant operation. (p. 111)



**After 40 hours—overtime?**

Neither impressive title nor impressive salary is your criterion. The law says that certain employees must be paid overtime for work beyond 40 hours a week. Here's your guide to who is exempt and who isn't. (p. 127)

# Chemical

DECEMBER 1, 1958

**Developments in Chemical Engineering**

**CHEMENTATOR**

New Furnace for Reforming Methane.....	49
Prestretched Mylar for LP Tape.....	49
New Foam Makes Better Insulation.....	51
Polypropylene Fiber Is on the Way.....	51
New Polyolefins Show Great Promise.....	54
Coming: Purer Metals at Lower Cost.....	54

**PROCESSES & TECHNOLOGY**

Chemical Plant Uses Home-Made Rectifiers.....	56
Fluid Bed Under Trial Regenerating Carbon.....	62
Nuclear Testing Moves Into Private Hands.....	66

**CHEMICAL ECONOMICS**

Which Nuclear Fuel Is Best? Nobody's Sure.....	72
--	----

**CHEMICAL PRODUCTS**

11 Newsworthy Chemicals and Raw Materials.....	76
--	----

**PROCESS EQUIPMENT**

22 Newsworthy Developments .....	80
----------------------------------	----

**Practice of Chemical Engineering**

**PROCESS FLOWSHEET**

Polystyrene Via "Natural" Ethyl Benzene.....	98
--	----

**FEATURE ARTICLES**

Assure Full Range Flow Control.....	107
Joseph Conison	
Checkup on Cooling Tower Operation.....	111
Eugene L. Bass, Nathaniel P. Green	
Shellside Heat Transfer Coefficient.....	117
Ning Hsing Chen	

**CE REFRESHER**

Estimate Efficiency in Mass Transfer.....	119
James O. Osborn	

# Engineering

Vol. 65, No. 24

## CE COST FILE

**Floating Head Exchangers**..... 123  
*H. J. Lamater*

## PLANT NOTEBOOK

**Flange-Inserted Thermowell Easy to Install**..... 125  
*W. M. Robinson, F. H. Allen*  
**Cutting Corrosion in Refrigerant Drying**..... 126  
*Jerome A. Steiner*  
**Get Seven Days' Records On a One-Day Chart**.. 126  
*D. C. Williams*  
**"Quickie" Substitute for a Venturi Meter**..... 126  
*G. L. Head*  
**Find Gas Velocity by Ammonia Injection**..... 126  
*R. L. Johnson*

## YOU & YOUR JOB

**Should Your Employer Pay You Overtime?**.. 127  
*Robley D. Stevens*

## CORROSION FORUM

**Nylon 6 for Process Applications**..... 130  
*D. L. Duncan*

## Other Regular Features

**Petrochemicals & Petroleum Refining Index**..... 5  
**Firms in the News** ..... 137  
**Convention Calendar** ..... 146  
**More New Equipment Developments**..... 148  
**Technical Bookshelf** ..... 156  
**Letters: Pro & Con** ..... 158  
**Classified Section** ..... 184  
**Equipment Searchlight** ..... 185

## Reader Service

**Guide to Technical Literature**..... 162  
**Reader Service Postcard**..... 177  
**Reprints Now Available** ..... 179  
**Advertisers in This Issue**..... 190

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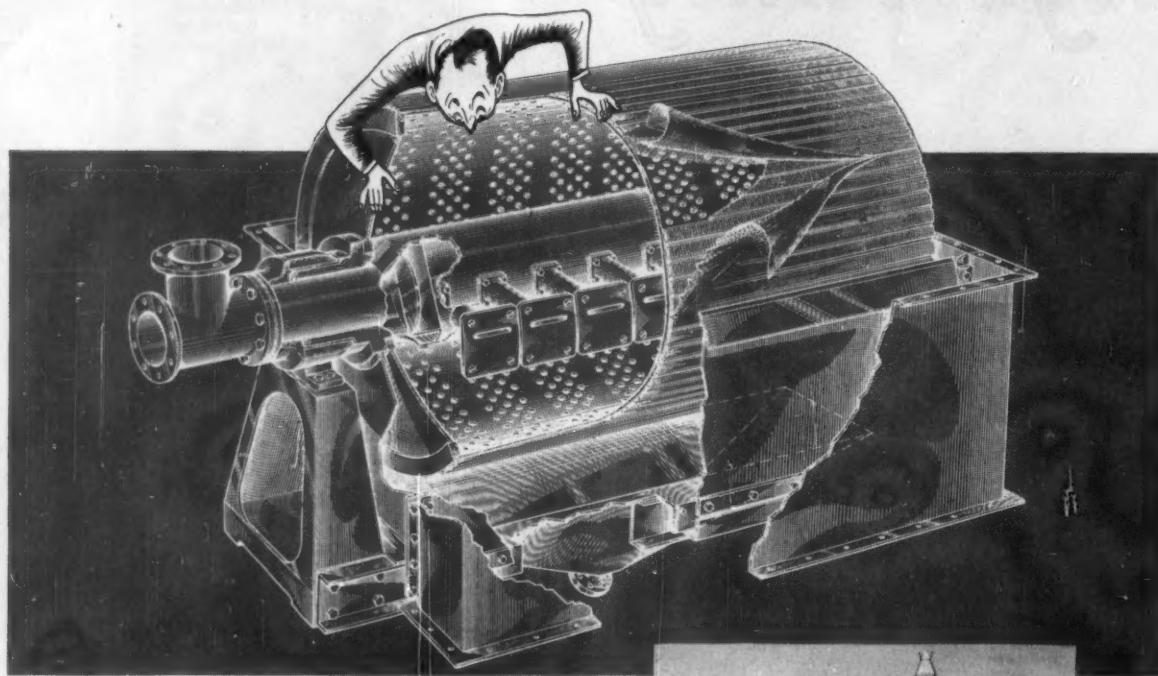
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CE is edited for the engineers who develop, design, build, operate, maintain and manage chemical operations of all types. More engineers subscribe to CE than to any other magazine in the field. Print order of this issue:

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## WHAT ARE YOU LOOKING FOR IN A VACUUM FILTER . . .



### HIGH OUTPUT FROM A SMALL PACKAGE?

The BIRD-YOUNG Rotary Vacuum Filter offers as much as *six to ten times the capacity* per foot of filter area as the ordinary drum filter.

It can handle slow filtering solids at high drum speeds to achieve high capacity.

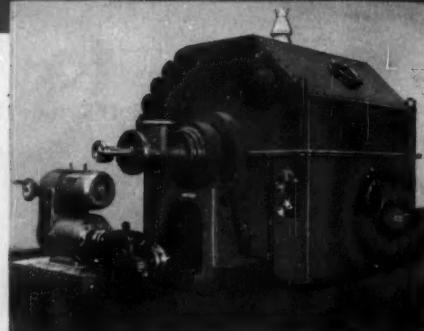
It can handle fast filtering solids at high rates because the Bird-Young design eliminates filtrate pipes that restrict flow.

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# Chemical Engineering

This issue's  
top features in...

## Petrochemicals & Petroleum Refining

DEC. 1, 1958

### Also of Basic Interest

Chemtator .....	49
Processes & Technology	
Power Rectifiers .....	56
Regenerating Carbon ..	62
Nuclear Testing .....	66
Chemical Economics	
Nuclear Fuels .....	72
Chemical Products .....	76
Process Equipment .....	80
Process Flowsheet .....	98
Feature Articles	
Cooling Towers .....	111
CE Refresher .....	119
CE Cost File	
Heat Exchangers .....	123
Plant Notebook .....	125
You & Your Job .....	127
Corrosion Forum	
Nylon-6 Applications ..	130
Firms in the News .....	137
Calendar .....	146
More New Equipment ..	148
Technical Bookshelf .....	156
Letters: Pro & Con .....	158
Technical Literature .....	162

Now: Polystyrene via "natural" ethyl benzene..... 98

Cosden Petroleum's polystyrene-from-crude-oil facilities feature integrated manufacture at one site—and faith in fractionation to win ethyl benzene from mixed xylenes.

How to design flow systems for full-range control..... 107

When you have control valves on the discharge side of centrifugal pumps, this return to fundamentals can help you design an effective, full-range flow control system.

Speed design of shellside-water-flow exchangers..... 117

Use these fast, easy charts to aid your calculations of transfer coefficients and pressure drops for water flow in segmental, baffled tubular exchangers.

How to estimate stage efficiency in mass transfer..... 119

Here are methods to calculate over-all, plate and point efficiencies in bubble-cap and sieve-plate columns; it's a thorough refresher on an important step.

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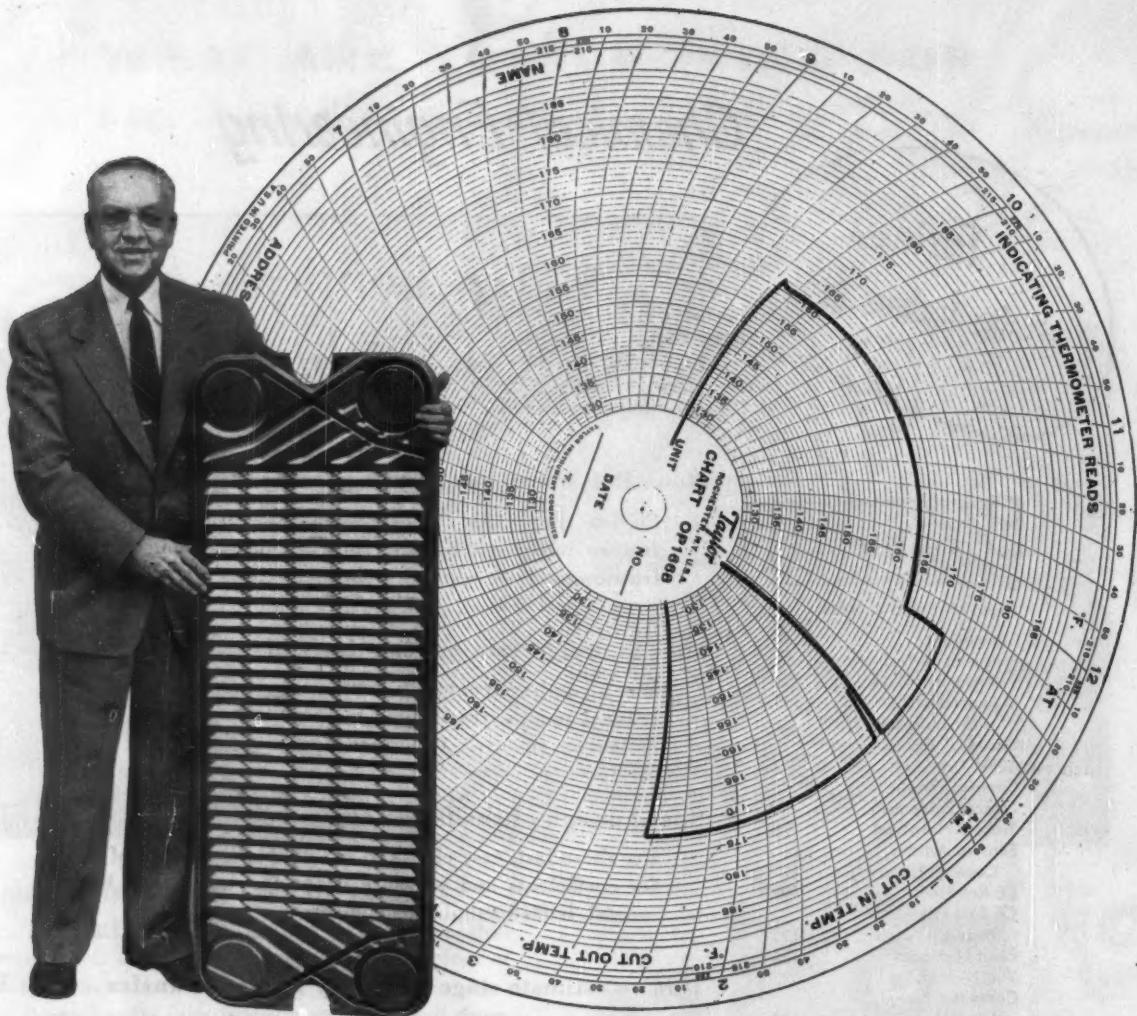
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**"Pinpoint accuracy in temperature control...  
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With a De Laval Plate Heat Exchanger, you can recover process heat that you're now wasting and incorporate it as a highly profitable supplement to your heating system. Or, if your process requires pinpoint accuracy in controlling product temperature over sustained periods of time, the De Laval unit holds the temperature precisely where it's supposed to be . . . no "seeking" or time-lag. The De Laval unit equipped with the exclusive Vacuum Steam Heating System responds immediately to changes in operating conditions and holds the required pre-set temperature to within 1° for as long as you want it.

**Simplicity is the key:** The assembled unit is a simple device. Plates like the one I'm holding in the illustration are assembled on two carrying bars between a holding frame. The product flows continuously in the space between alternate plates, and the heating or cooling medi-

um flows countercurrent between the adjacent spaces. The plates are spaced so that the liquids flow in comparatively thin layers, and the exclusive corrugated design insures maximum turbulence in the liquid flows. These two factors make heat transfer rapid and uniform.

**Easy to install:** You can install a De Laval Plate Heat Exchanger in any available, convenient spot in your plant. It requires a minimum of space, and the unit is shipped completely assembled. All you do is add pumps, piping and controls and the unit is ready to operate. Since heat transfer and connecting plates can be individually added or removed, the system can be easily rearranged at any time to perform any or all of its functions . . . heating, cooling or heat transfer.

**Custom-tailored units:** The savings you realize with a De Laval Plate Heat Exchanger start from the moment

of purchase. You're getting custom equipment without paying custom prices. As soon as we get your process data, our engineers draw up the specifications for a unit tailor-made to fit your needs. They select from ten basic frames according to capacity, content and function, and calculate the correct number and arrangement of plates. The unit is custom assembled and tested at our factory before shipment to you.

**Pinpoint temperature control:** You can maintain as little as 3° temperature differential between product and heating or cooling medium in a De Laval unit. It not only gives maximum utilization of heating/cooling medium, it also gives complete protection against thermal shock and burn-on. Product uniformity and purity are 100% protected.

**For example:** As every connoisseur knows, wine may lose its natural flavor or bouquet unless temperature stabilization is carefully controlled. Roma Winery, Fresno, California, uses a De Laval Plate Heat Exchanger in three sections to achieve complete control of temperature changes in processing its fine products. The wine enters the first section of the exchanger and is pre-heated, drawing heat from wine returning from the second section where it has been heated under precision controls to the exact stabilizing temperature required in the process. Having given up much of its heat, the wine then enters the third section of the exchanger where it flows counter-current to water and is cooled to the required outlet temperature.

**Easy to clean:** When cleaning is necessary, it's a simple matter. Under most circumstances, you simply circulate a cleaning solution at high velocity to clean the unit thoroughly. When manual cleaning is desired, it still takes only a few minutes. By simply loosening the two tightening end nuts and sliding the plates along the carrying bar, all heat transfer surfaces are quickly exposed for hosing or hand brushing and visual inspection. Slide

the plates back together, tighten the end nuts, and the unit is ready to operate again.

**Corrosion control:** The plate I'm holding illustrates some of the corrosion control features of the plate heat exchanger. The heat transfer plates are made in either type 304 or 316 heavy-gauge stainless steel — both types of .049 inch thickness. The use of stainless steel permits the processing of many corrosive liquids. Further, the high velocity and great turbulence of liquids processed in the plate heat exchanger tend to discourage corrosion by preventing any settling. And the plates are easy to clean as noted above.

**A case in point:** The Wisconsin Rapids plant of CONSOLIDATED WATER POWER AND PAPER COMPANY had trouble keeping its log soaking pond at the required temperature, especially during the cold months. They'd been blowing live steam into the pond, a system which was both costly and inefficient.

Now, with a De Laval Plate Heat Exchanger, they recover 10,800,000 BTU per hour from spent sulphite liquor, all of which had been going to waste previously. They maintain the water temperature in the pond at a constant 91°F. by continuous recirculation through one section of the exchanger, handling 288,000 lbs. of water per hour.

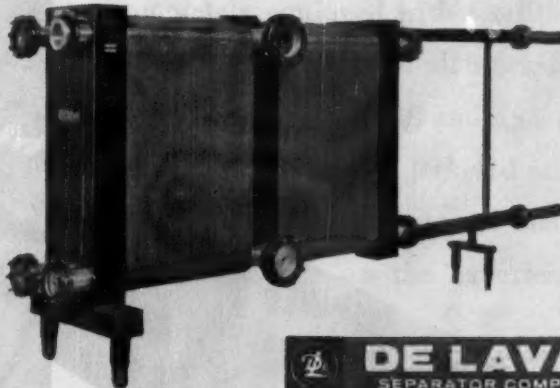
Another section of the exchanger uses recaptured heat from the same source to pre-heat 45,000 lbs. of process water per hour from 34°F. to 138°F.

The unit doing this remarkable job with the highly corrosive spent sulphite liquor is also remarkably small: only 96-inches long, 72-inches high and 33-inches wide.

**SEND FOR YOUR FREE COPY OF OUR ILLUSTRATED BOOKLET NO. S. A1067 ON THE DE LAVAL PLATE HEAT EXCHANGER. MORE DETAILS AND SPECIFIC EXAMPLES OF BETTER PROCESS CONTROL AND PROFITABLE HEAT RECOVERY. DROP US A LINE ON YOUR LETTERHEAD.**

**COMPACT** Requires roughly  $\frac{1}{4}$  the heat transfer surface of a shell & tube unit.

**EASY TO CLEAN** Loosening two end-nuts quickly exposes all heat transfer surfaces... broad and flat for rapid cleaning.



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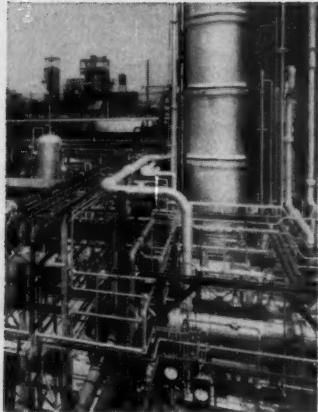
# Specialized



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The fabrication of complex piping arrangements—which often exceed the capabilities of ordinary pipe shops—is a specialized activity at Vulcan. Here all work is supervised by master metalsmiths who are intimately familiar with the problems of fabricating stainless, copper and many other metals and alloys.

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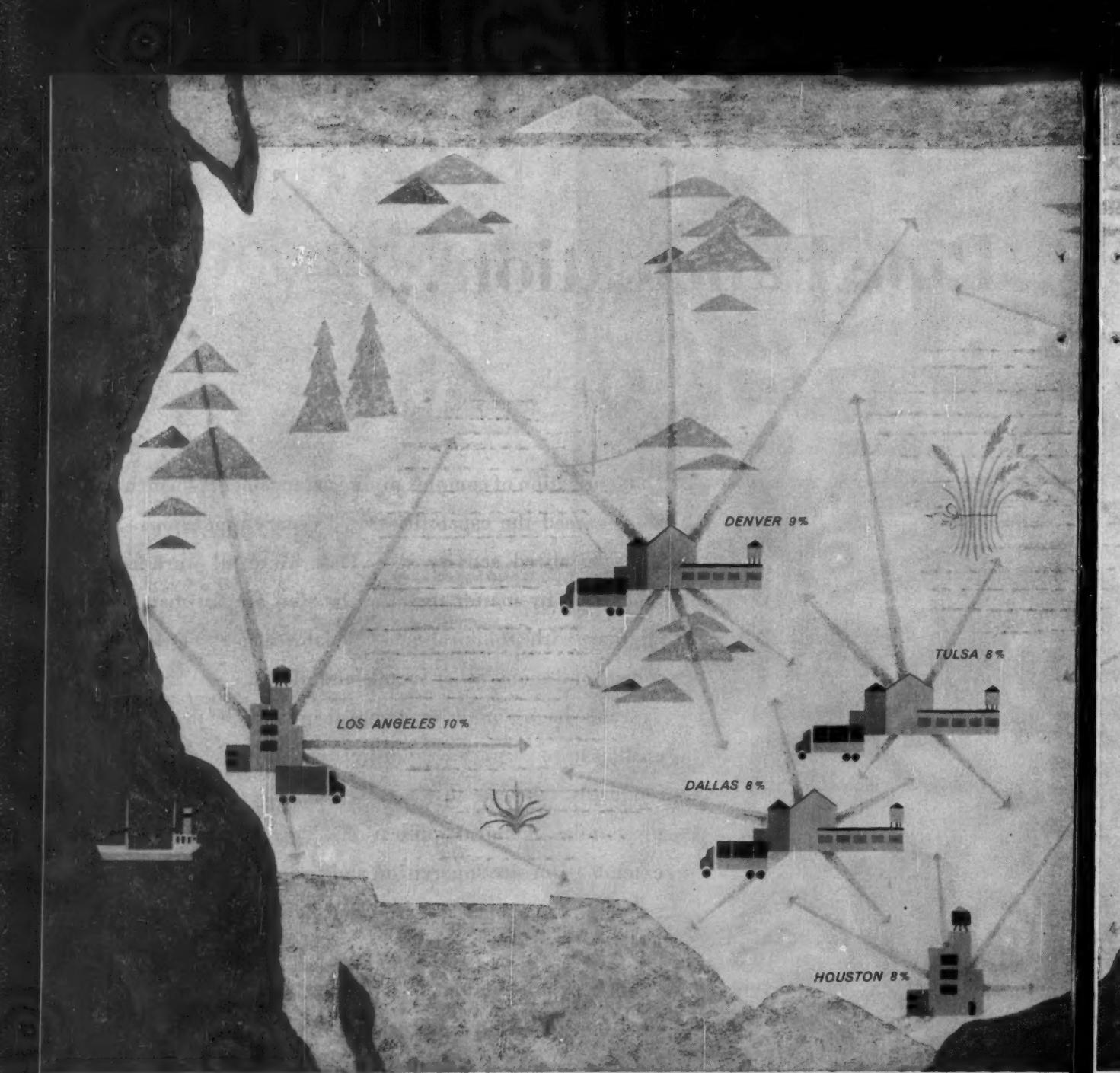
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CHEMICAL ENGINEERING—December 1, 1958



## NEW SAVINGS ON

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to see how much  
less you pay!

Refer to Chemical Engineering Catalog for Detailed  
Description of Worthington Standard Pumps

Worthington has reduced the cost of SESC pumps by spanning the nation with *new regional assembly depots*. In addition to the primary depot in East Orange, (N.J.), others have been established in Cleveland, Atlanta, St. Louis, Houston and Los Angeles. Worthington can now pass along savings to you in three ways. One, on the price: as much as 10% depending upon your location. Two, on time—because your order can be processed and shipped in a matter of hours. Three, on parts service—because each of the assembly depots maintains a stock of spare parts.

In addition to assembly points, Worthington also maintains stocks of completely built pumps in Buffalo, Chicago, Denver, New Orleans, Dallas and Tulsa.

But there are other reasons why SESC (standard end



Because you pay only freight charges from the nearest assembly depot, Worthington pumps now cost you up to 10% less. Map shows how much you save on the total cost of a pump at each assembly depot or warehouse.

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suction centrifugal) is far and away your best pump buy. Standardization gives you a high degree of interchangeability. Pumps may be all iron, all bronze, standard fitted, or Worthite\*. 120 different sizes, with open or closed impellers are available with capacities up to 2700 GPM and heads to 550 Ft. Conventionally packed boxes or mechanical seals are optional in all pumps, and conversions from packed boxes to seals may be made on units in the field. All in all there are 70,480 modifications of the SESC pump to choose from—the broadest combination the pump industry has to offer.

SESC pumps also give you these benefits of standardization. You can cut your spare parts inventory by 50% because only four bearing frame sizes are used for the entire 120-pump line, and all pump parts are interchangeable.

This means reduced downtime if repair or conversion is made. Finally, one basic design for the complete line simplifies maintenance and lowers overall operating costs.

Take advantage of the new low costs—the speeded delivery—the many outstanding features of the Worthington SESC line now. For detailed information, write for Bulletin W-300-B-4-B. Worthington Corporation, Section 20-3, Harrison, New Jersey. In Canada: Worthington, Ltd., Brantford, Ontario.

\*Worthite is a high nickel, high-chromium, low-carbon alloy steel. Trademark Reg. U. S. Pat. Off.

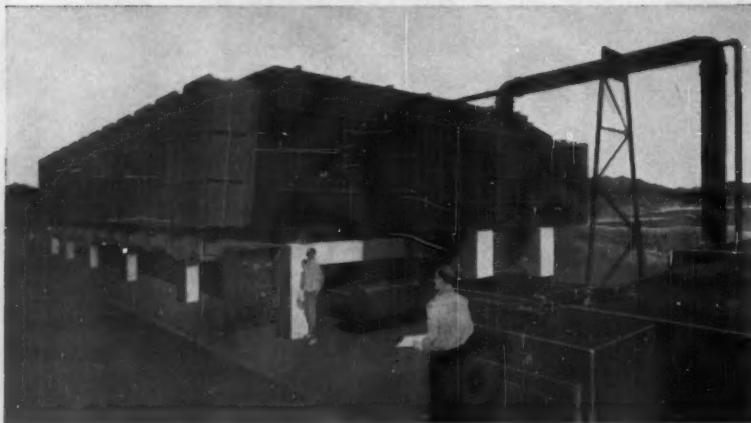
# WORTHINGTON

# FRESH WATER NEWS

from Cleaver Brooks

CAPSULE REPORTS AND INFORMATION ON THE PRODUCTION OF FRESH WATER FROM THE SEA

## Low-cost fresh water from the sea



One and one-quarter million gallons per day sea water distilling plant. (Designer's concept)

Waukesha, Wis.—Company engineers report additional progress toward reduction of cost of fresh water from the sea using flash evaporators of conventional design.

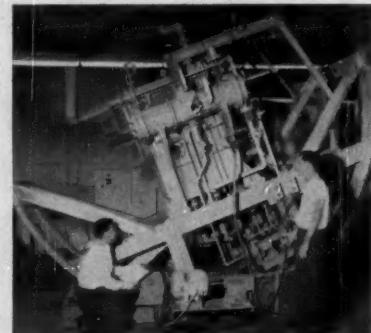
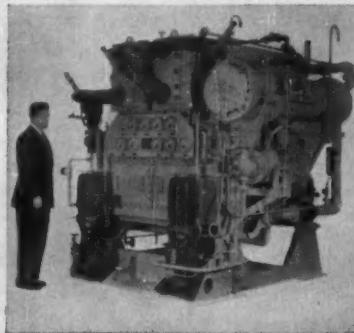
A typical study of a large municipal plant (the heat source is extraction steam from a turbine generating station), including all transportation, erection, storage, interest, insurance, amortization, fuel, power and maintenance, etc., shows a fresh water cost of about \$1.00/

1000 gallons based upon 20-year amortization, 8.5¢/gallon fuel and not including distribution. With lower fuel costs or waste energy as a heat source the cost of water may be reduced  $\frac{1}{2}$  of the above.

New developments on the drawing board anticipate further reductions of 15 to 20% as possible. Detailed studies can be made for any sea-side community and inquiries are invited.

### NEW GUIDED MISSILE DESTROYERS GET CLEAVER-BROOKS FLASH EVAPORATORS

The Navy's latest guided missile destroyers, DDG 4, 5, 6, 9 and 14, to be built at the New York Shipbuilding Corp. and Todd Shipyards, will be equipped with Cleaver-Brooks Flash Evaporators, capable of supplying each ship with 24,000 gals. of fresh water per day . . . flashed from the sea.



"ROCK AND ROLL" TEST FOR SEA-GOING EVAPORATORS

This tester developed by Cleaver-Brooks rocks a flash evaporator as much as 45° from horizontal to prove its efficiency under actual shipboard operating conditions.

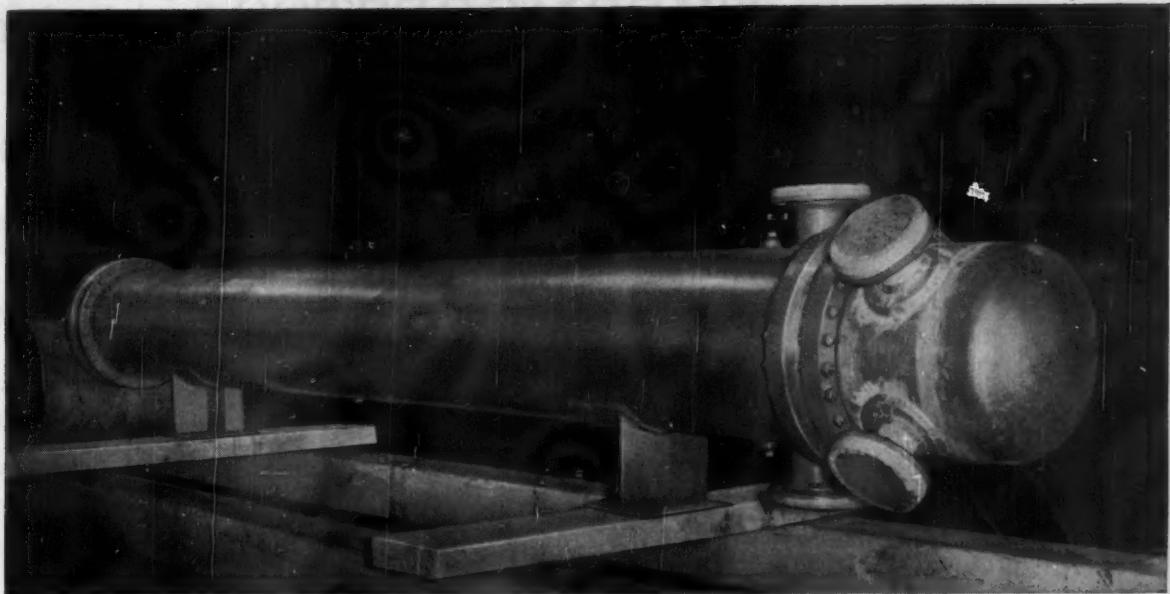
The illustrated model is presently at the Cleaver-Brooks sea-side testing laboratory site in North Carolina where a series of tests is being run to investigate performance and cost-reduction improvement.

The rocking fixture was the first of its type and is available to check the effects of a rolling sea on any new design improvements before they are incorporated into production models. Continual improvements are expected to keep Cleaver-Brooks far ahead in the sea water evaporator field, and laboratory testing facilities are being rapidly expanded.

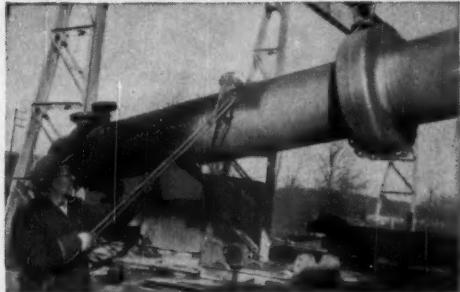
New for Off-Shore Rigs: Watch for a completely new Cleaver-Brooks waste-heat evaporator — soon to be announced. It's more compact — offers greatest economies in production of fresh water on board.

For helpful suggestions that solve your fresh water problems send details to: Dept. CE128, Cleaver-Brooks Special Products, Inc., 225 Grand Avenue, Waukesha, Wisconsin.

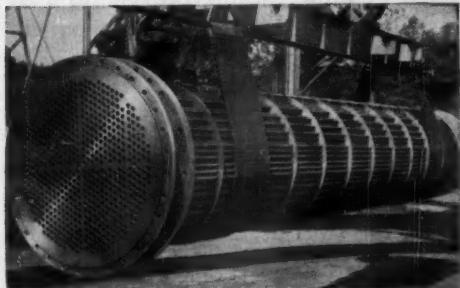
**SPECIAL ANNOUNCEMENT:** In keeping with its continuing expansion the Special Products Division of the Cleaver-Brooks Company is now a separate corporation with the name CLEAVER-BROOKS SPECIAL PRODUCTS, INC.



## Aluminum translated by Downingtown... metallurgically speaking



Putting the finishing touch on another heat exchanger unit built by Downingtown.



We rolled type 329 stainless steel tubes into types 316 and 304 tube sheets in making this stainless steel replacement bundle.

The special problems of aluminum welding and fabrication are another metallurgical "language" that has been expertly mastered at Downingtown. In this fixed-tube sheet heat exchanger unit, aluminum heads, tubes and tube sheets have been combined with a carbon steel shell to meet specific service conditions.

When heat transfer specifications call for aluminum...or aluminum bronze, nickel, copper, stainless steel, or almost any clad or alloy...you'll find the metallurgical idiosyncrasies are well understood at Downingtown. Send for our informative booklet on heat exchanger design.

### SPECIFICATIONS OF THE UNIT

**Materials:** Aluminum Tube Side and Carbon Steel Shell

**Tubes:** 192 Alclad Tubes,  $\frac{3}{4}$ " O.D. x 16 ga. x 14'0" L

**Shell Diameter:** 18"

**Over-All Length:** 16' 1"

**Design Pressure:** Shell Side, 100 psi—Tube Side, 200 psi

**Test Pressure:** Shell Side, 150 psi—Tube Side, 300 psi

**Design Temperature:** Shell Side, 250° F.—Tube Side, 350° F.

**Code Stamped:** Inspected by Purchaser and Hartford

### Downingtown Iron Works, Inc.

140 Wallace Ave., Downingtown, Pennsylvania

division of **PRESSED STEEL TANK COMPANY** Milwaukee  
Branch offices in principal cities

**HEAT EXCHANGERS—STEEL AND ALLOY PLATE FABRICATION  
CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS**



# In developing THERMOBESTOS Insulation



**Not damaged by water.** Thermobestos has the moisture resistance outdoor service demands. Soak it in water for one day or 365—and you can still walk on it without damage. Dry it out and Thermobestos is as good as new, with conductivity and structural strength unimpaired.

**Low Conductivity.** The low thermal conductivity of Thermobestos is best demonstrated in actual service where it makes possible accurate, uniform temperature control, helps reduce fuel costs and contributes materially to operating efficiency.

## Johns-Manville

for outdoor process industry applications

# research scientists didn't stop top insulating effectiveness...



*They added the three physical properties you most wanted—  
**HIGH STRENGTH—LIGHT WEIGHT—MOISTURE RESISTANCE!***

Thermobestos® offers the lowest k factor of all insulations in general use throughout the process industries. For maximum heat control on outdoor piping and equipment operating at temperatures to 1200F it just can't be beat!

Yet top insulating effectiveness is only one reason why more and more engineers are specifying Thermobestos for refineries, chemical plants, and wherever hot outdoor vessels and piping must be insulated. For Thermobestos also offers a threefold bonus . . .

#### **... Three outstanding physical properties**

Thermobestos is 1) strong and rigid. Its hard composition resists crushing and easily withstands unusual service abuse. Yet it is 2) lightweight for easy handling and fast application. And it is 3) highly moisture resistant, remains

undamaged even by prolonged wetting.

#### **Quickly, easily applied**

Thermobestos is made from hydrous calcium silicate . . . molded to size for proper fit. Its high strength makes it particularly adaptable for time-saving shop prefabrication of fittings and bends.

Furnished in large sections, Thermobestos is easy to apply. It reduces the number of joints. In pipe insulation form, it comes in a complete selection of sizes up to 30" O. D. Also available in 6" x 36" and 12" x 36" blocks in a full range of thicknesses.

For further information write for your free copy of the 12-page Thermobestos booklet, IN-169A. Address Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

## **INSULATIONS**

**FOR LASTING THERMAL EFFICIENCY**  
**MATERIALS • ENGINEERING • APPLICATION**

JOHNS-MANVILLE  
**JM**  
PRODUCTS

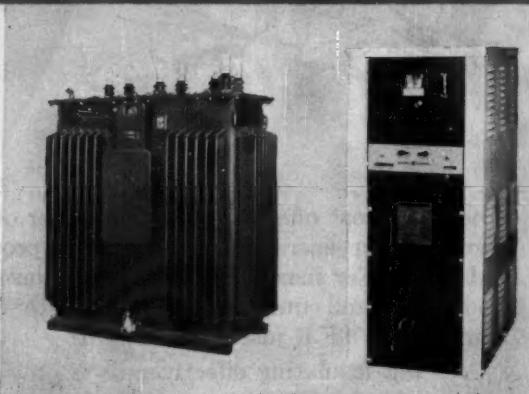
**Designed to provide up to 96% efficiency,  
General Electric semiconductor  
power rectifier systems offer  
reliable, economical power conversion  
for the electrochemical industry**

**Typical General Electric Rectification System:**



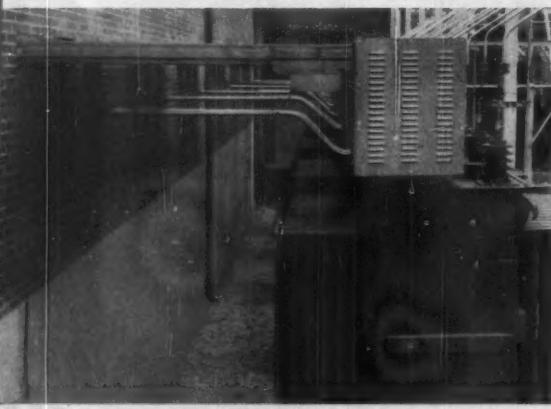
**1**

SYSTEM COORDINATED General Electric metal-clad switchgear equipment handles normal switching functions and provides dependable a-c short-circuit protection.



**2**

LIQUID IMMERSSED (l.) or dry-type (r.) Inductrol® voltage regulators compensate for system regulation and a-c supply variations to provide d-c control at desired voltage levels.



**4**

SYSTEM INTEGRATED BUSWAY—an interleaved 3-phase design completes connection to rectifier. Busway provides greater flexibility . . . reduced installation costs.



**5**

COMPACT, EFFICIENT rectifier sections convert alternating current to direct current for process requirements. D-c current transformers, mounted on d-c buses, measure output.

**In the last few years**, General Electric has supplied semiconductor power rectifier systems for over 85 electrochemical installations. Users report that these systems—designed to provide over 90% efficiency above 15 volts d-c, and from 94 to 96% efficiency above 60 volts d-c—have increased system reliability and reduced installation and operating costs.

**Coordinated System Components Provide Peak Performance, Longer Life**—Because each electrochemical facility requires special d-c voltages for its particular process needs, power rectifier systems should be tailored to each installation for maximum reliability and economy. For this reason, General Electric manufactures all major power rectifier system components—including air-cooled and water-cooled, germanium and silicon rectifiers—and is fully equipped to provide installation and service assistance on all components.

**G-E Semiconductor Power Conversion Systems Find Wide Application**—Due to their greater efficiency and economy, General Electric rectifier systems have enjoyed widespread acceptance as d-c power sources in hydrogen,

chlorine and fluorine plants; copper refining, aluminum reduction, tin-plating, chrome-plating and aluminum anodizing processes; and for powering d-c motors. New uses for these versatile dependable power conversion systems are continually being developed.

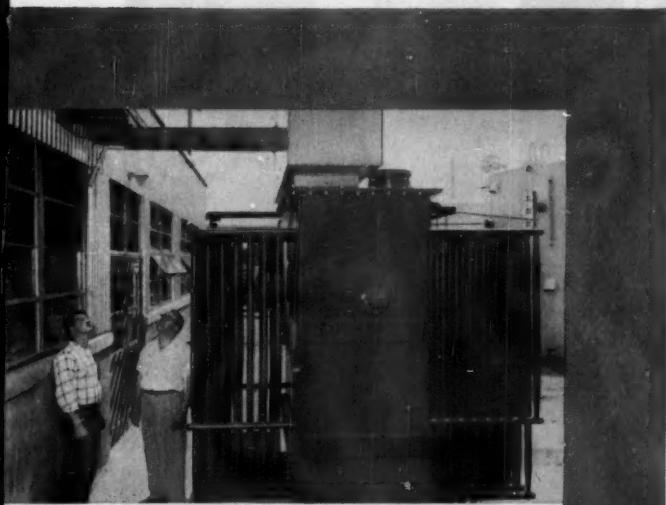
**For Complete Information** on General Electric *system-engineered* and *performance-proven* semiconductor power rectifier systems, contact your nearby General Electric Apparatus Sales Office. Your G-E sales representative can help specify semiconductor power rectifier equipment specifically tailored to your process needs.

**Write G-E Co.**, Section 686-1, Schenectady 5, New York, for These Free Bulletins: GEA-6684, Semiconductor Rectifier Power Conversion Systems for Electrolytic Processes; GEA-6375A, Semiconductor Power Rectifiers.

### Engineered Electrical Systems for the Electrochemical Industry

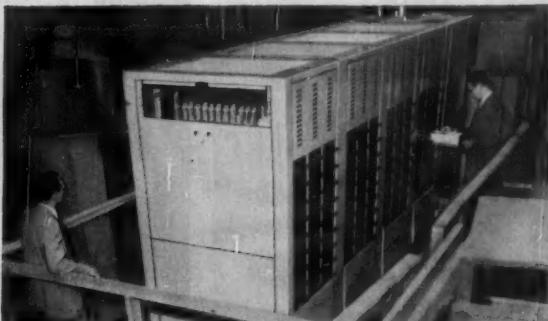
**GENERAL  ELECTRIC**

### General Electric Offers Both Air and Water-cooled Rectifiers

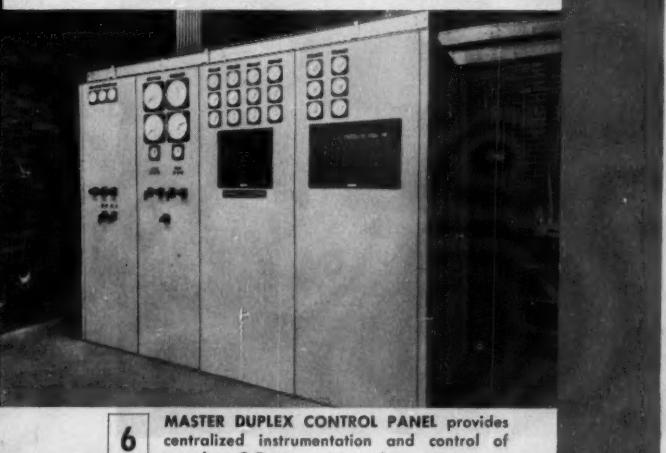


3

G-E RECTIFIER TRANSFORMER gives proper ratio of a-c primary to desired conversion voltage . . . can be located out-of-doors.

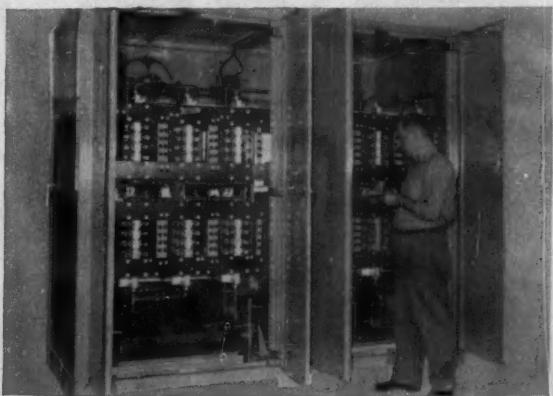


G-E AIR COOLED semiconductor power rectifiers are recommended for systems where d-c voltages exceed 400 volts. Trays contain several series rectifier cell assemblies, fuse, fuse monitor and indicating lights.



6

MASTER DUPLEX CONTROL PANEL provides centralized instrumentation and control of complete G-E power conversion system.



DIRECT WATER-COOLED G-E rectifier units are used in systems where d-c voltages do not exceed 400-v. Internally mounted air-cooled transformers (above) are sometimes used in smaller systems.

# Rockwood Double Strength Foam



3 Parts Rockwood  
Foam liquid—



+97 Parts Water



+900 Parts Air

# Adds Up To SAVINGS



Gives you 1000 gallons  
of fire extinguishing agent  
at 1½ cents a gallon

= Fast, Low-Cost Fire Extinguishing Agent

**Rockwood Double Strength FOAM**  
liquid binds large volumes of air and water into a fast, inexpensive fire extinguishing agent. It can save you hundreds, even thousands of dollars in the cost of your fire fighting materials.

If you use other types of fire extinguishing agents — you're paying for 100% of the extinguishing agent, plus storage and shipping. With Rockwood FOAM you're paying for only 3 tenths of 1% and shipping costs are less — storage costs greatly reduced!

Get all the money-saving facts. Send in the coupon below for complete information. Tested and listed by Underwriters' Laboratories, Inc. Distributors in all principal cities.

## ROCKWOOD SPRINKLER COMPANY

Engineers Water  
... to Cut Fire Losses



ROCKWOOD SPRINKLER COMPANY  
Portable Fire Protection Division  
1326 Harlow Street  
Worcester 5, Massachusetts

Please send me your illustrated booklet on Rockwood fire-fighting products.

Name.....

Title.....

Company.....

Street.....

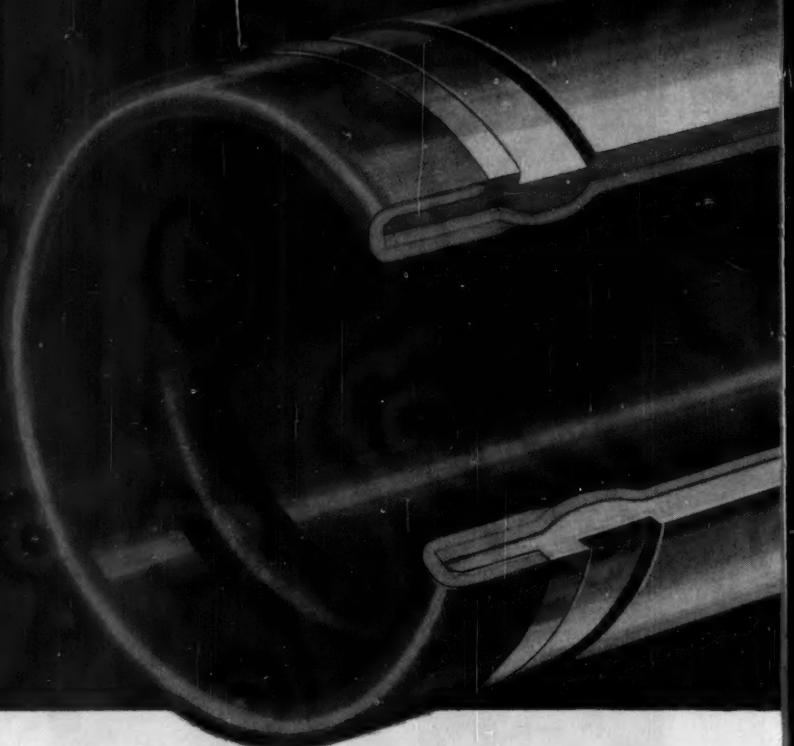
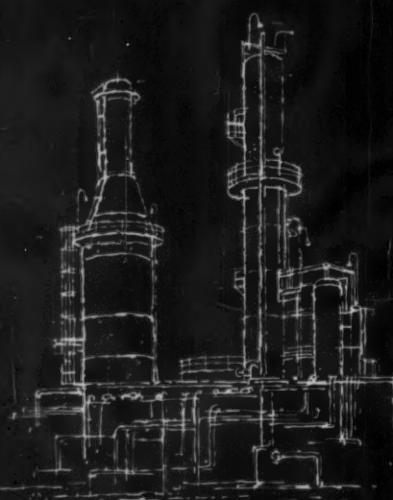
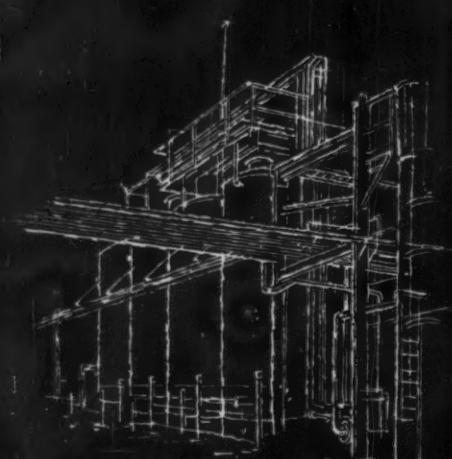
City.....

Zone..... State.....

# NEW "JAL-

handles corrosive liquids

- at pressures to 1000 P.S.I.
- at temperatures to 150° F.



New "Jal-Jacket" pipe, combining the corrosion resistance of rigid polyvinyl chloride with the strength of steel, offers you these cost-cutting advantages in handling corrosive liquids.

**LOW INITIAL COST.** "Jal-Jacket" pipe costs less than other lined metal pipe.

**LOW COST INSTALLATION AND MAINTENANCE.** Ends grooved for Victaulic couplings permit

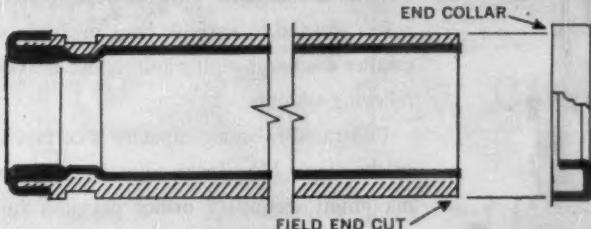
quick, easy make-up. Entire systems can be dismantled and re-assembled without damage to the PVC lining. "Jal-Jacket" can be cut to length and joined on the job. Requires no troughs or other costly supporting devices.

**LONGER SERVICE LIFE.** Plastic liner is bonded securely to the steel jacket. The ends are fully protected with plastic providing continuous protection from chemical attack. Steel jacket assures a tough, rugged product.

## Jones & Laughlin Steel Corporation

PITTSBURGH, PENNSYLVANIA

# JACKET" PIPE\*



\*a rigid unplasticized polyvinyl chloride tube jacketed with electric-resistance welded steel pipe.

"Jal-Jacket" is currently available in 20 foot mill lengths in three sizes, 2 $\frac{3}{8}$ ", 3 $\frac{1}{2}$ ", 4 $\frac{1}{2}$ " O.D. Get complete details by mailing this coupon today.

## Jones & Laughlin Steel Corporation

3 Gateway Center, Pittsburgh 30, Pa.

Send information on "Jal-Jacket"  
 Have J&L representative call

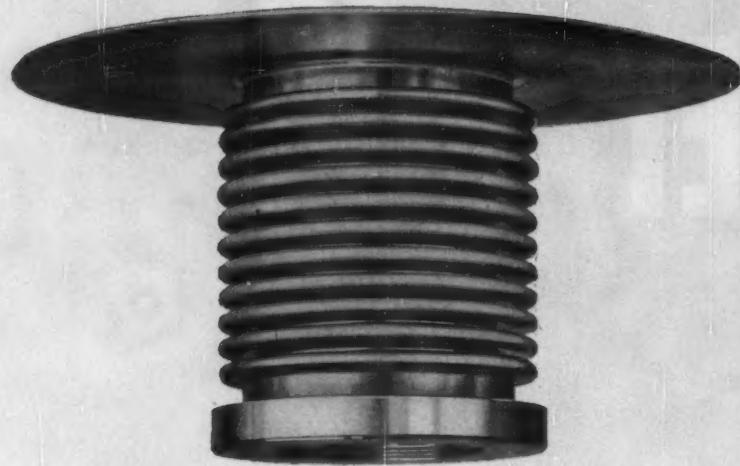
Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_



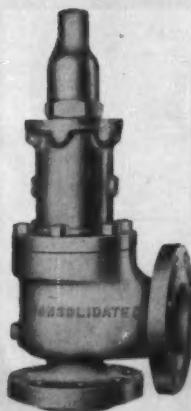
## CORRUGATED SLEEVE

shields working parts

A durable, two-ply stainless steel Sealing Bellows in Consolidated Safety Relief Valves isolates contaminants, corrosion or viscous fluids from the working parts. The Bellows is balanced with the seating surface. Capacity is less affected by variable back pressure, so you can use smaller discharge piping and reduce the cost of pressure-relieving systems.

Full-rated relieving capacity is certain at all positions of the single blowdown adjusting ring because a fixed maximum secondary orifice provides full lift at 10% overpressure. Even with superimposed back pressure in the relieving system, valve action is consistently positive.

Protection of working parts is but one of many reasons why Bellows Type Consolidated Safety Relief Valves assure absolute protection for personnel and facilities. Write for details, including facts about the Standard valve that you can convert to the Bellows type in your own shop. Ask for Catalog 1900.



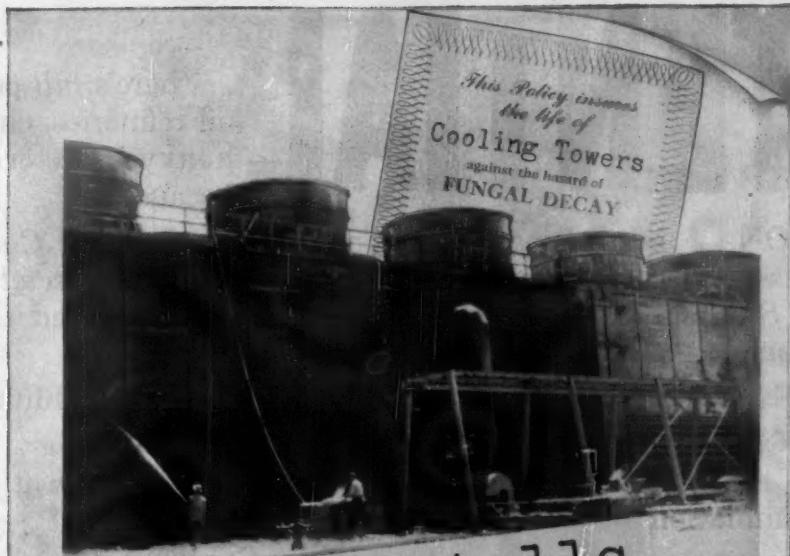
Consolidated Safety Relief Valve with Sealing Bellows. Type 1900-30 Series. Sizes: 1½" x 2" to 8" x 10".



## CONSOLIDATED SAFETY RELIEF VALVES

*A product of*  
**MANNING, MAXWELL & MOORE, INC.**

Consolidated Ashcroft Hancock Division • Tulsa, Oklahoma  
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario



NEW FREE BOOKLET tells  
**MARTREAT**

Prolongs Life of

how to add YEARS to the life

of your COOLING TOWER . . .

Marley for MARTREAT wood preservative application are those with the manpower, facilities and resources to thoroughly investigate and evaluate the necessity for and profitability of

reports and technical

Cooling towers in all parts of the country were inspected for visible evidence of fungus attack. Wood samples from infected towers were microscopically and culturally

subjected to the toxic effects of various chemicals and chemical compounds in differing dilutions. Immunity and vulnerability of each strain were carefully

The long-range

at low cost!

Marley's exclusive MARTREAT® process is the proven way to halt fungal decay and add years to the life of your water cooling tower—and it can be economically applied to any cooling tower now in service, regardless of age or make.

A new informative Martreat Bulletin sums up Marley's years of leadership and experience in preservative wood treatment for cooling towers—pinpoints the organisms that destroy the effective performance of your tower and eat away your investment . . . prescribes the treatment that arrests these destructive organisms, and its application techniques . . .

demonstrates the efficacy of the Martreat process . . . documents industry's whole-hearted acceptance of this unique wood preservative treatment.

Only Marley can offer you this form of "cooling tower life insurance" backed by successful treatment of more than four million board feet of cooling tower lumber for the country's largest industrial organizations (name list available) in the petroleum, power, chemical and food processing industries. Write today or ask your Marley representative in any of 56 cities for the new MARTREAT BULLETIN MT-58.

Also available—descriptive folder on Marley's complete engineered reconstruction services



**The Marley Company**

Kansas City, Missouri

# POTENTIAL

... here's *full* potential for oil refineries, chemical and heavy industrial plants, because ...

FABRICATION ... of all types of equipment (*Fractionating Columns, Gas Columns, Pressure Vessels, Plate and Heavy Steel Work, Special Machines, Autoclaves, Shells, Base Bridge Girders*) ... is performed to order ... to specification.

MACHINING ... fully equipped, flexible facilities for machining to close tolerances, regardless of product size or design.

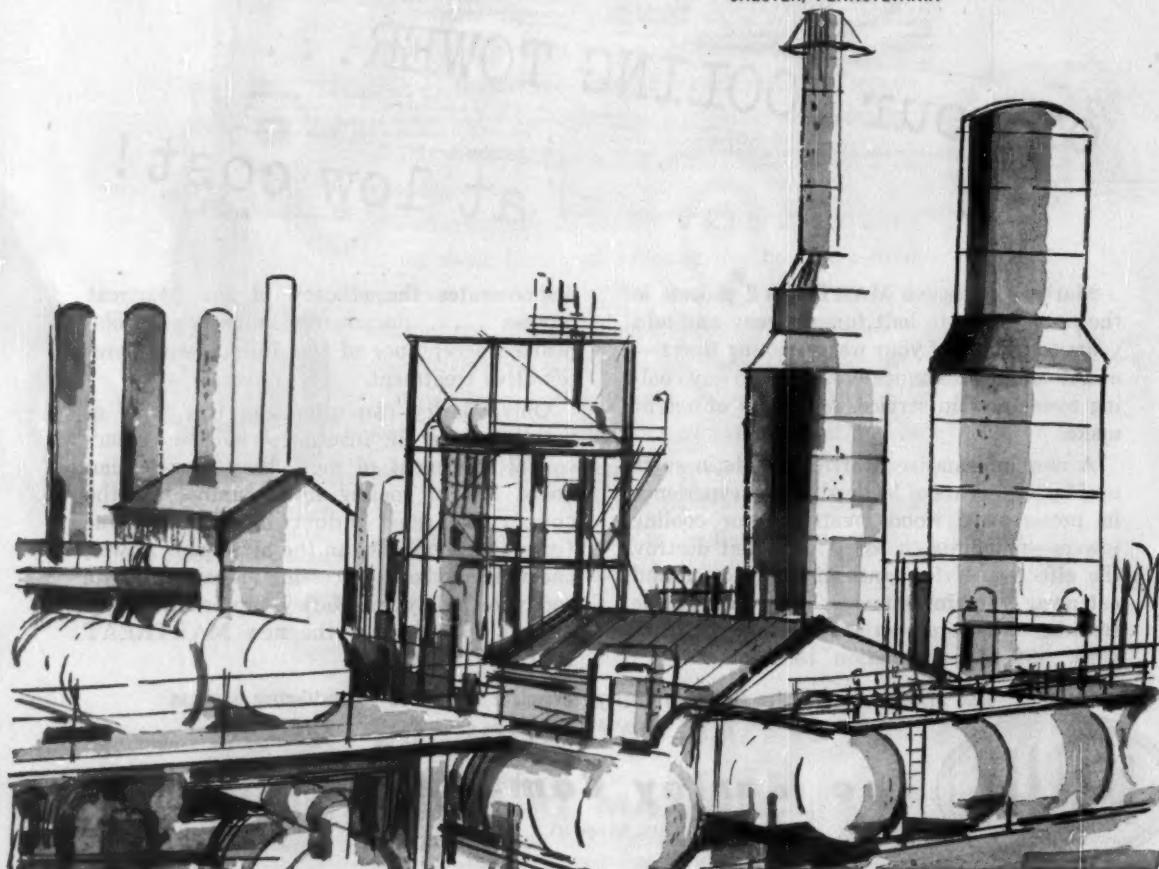
STAINLESS ... separate, integrated shop for stainless fabrication protects against contamination by ordinary steel.

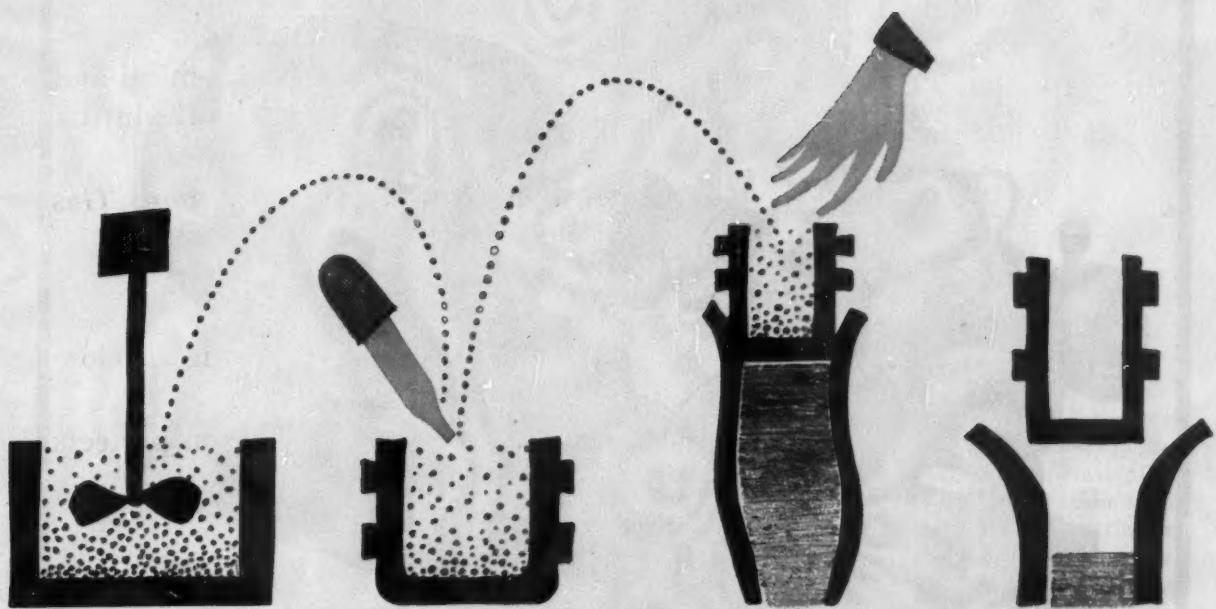
DELIVERY ... by rail, truck or inland, coastal or overseas waterway.

Through integrated, efficient operation, Sun Ship can reduce costs ... increase your POTENTIAL. Call for an estimator or representative.

**SUN SHIP**

BUILDING & DRYDOCK CO.  
CHESTER, PENNSYLVANIA



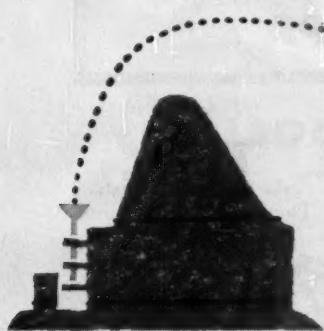


1. Prepare suspension of particles.

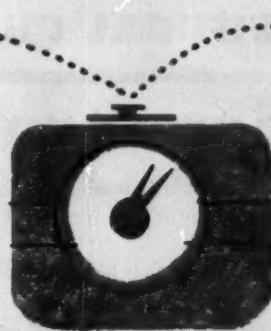
2. Transfer suspension to feeding chamber.

3. Transfer feeding chamber to centrifuge tube.

4. Remove feeding chamber, leaving sharp layer of suspension on top of sedimentation liquid.



5. Read sediment height under gravity in projector at precalculated times.



6. Transfer to first centrifuge and run for precalculated time, then remove and read in projector.



7. Repeat centrifuging in same unit or in higher speed centrifuges until run is complete.



8. Size distribution is obtained from sediment height data.

## New Low-Cost Way to Measure Size Distribution of Small Particles

With the new M-S-A® Particle Size Analyzer, you can start with a minimum investment for measuring particle distribution, and then expand it by the purchase of additional components.

This versatile analyzer is a general-purpose device for measuring size distribution of small particles. It is especially designed for measurement of subsieve par-

ticles between approximately 0.1 and 40 microns. Most airborne dusts, paint pigments, and many flours, chemicals, and pharmaceuticals lie within this range.

Complete analyzer system includes centrifuge tubes, feeding chamber, optical tube projector, one or more special centrifuges, and tube handling and cleaning accessories. Write for new bulletin for details.



Tube Projector

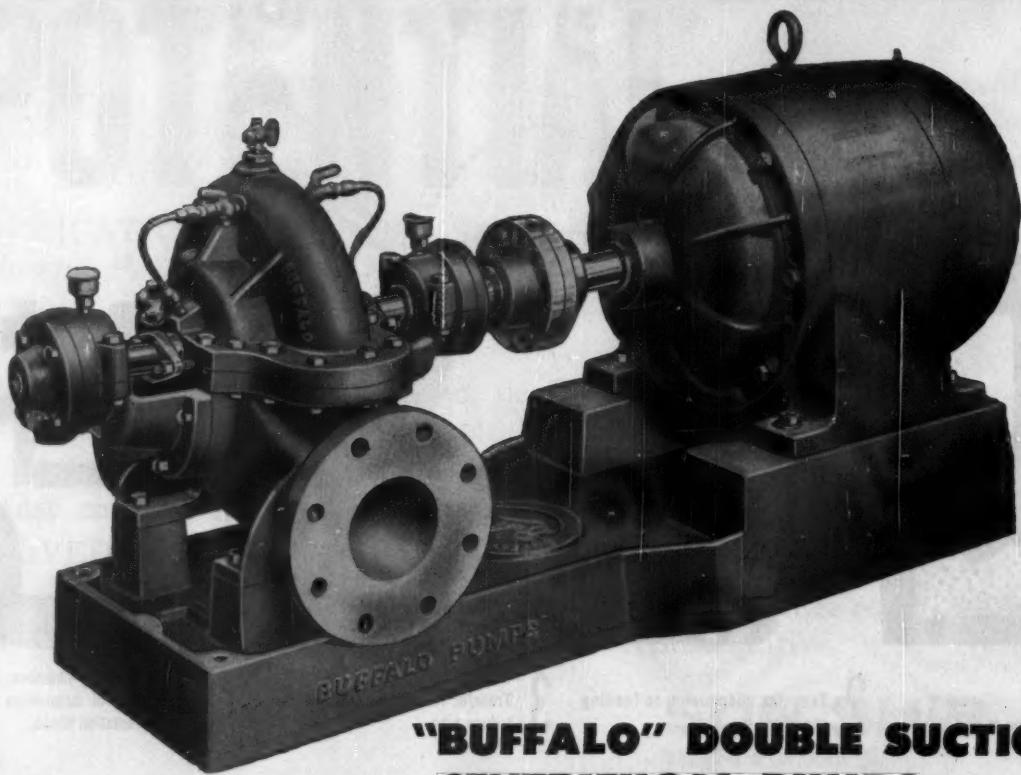


Centrifuges



### INSTRUMENT DIVISION

Mine Safety Appliances Company  
Pittsburgh 8, Pennsylvania



## "BUFFALO" DOUBLE SUCTION CENTRIFUGAL PUMPS

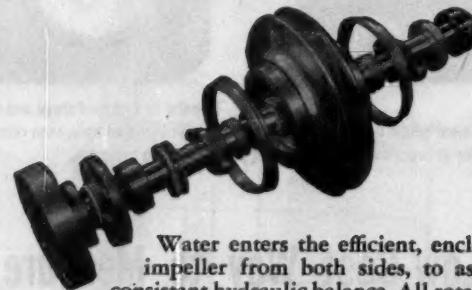
### OFFER MORE FOR YOUR PUMP DOLLAR

- Long Life
- High Efficiency
- Quiet Operation
- Reliability
- Minimum Down Time for Repairs
- Availability of Replacement Parts

"Buffalo" Pumps' engineering and rugged, dependable construction make them highly desirable for demanding industrial service. For example, "Buffalo" Double Suction Pumps for dependable clear water service feature precision-machined casings with ample water passages — impellers designed for highest efficiencies — bronze wearing rings — sturdy shafts and heavy-duty ball bearings.

The complete line of "Buffalo" Double Suction Pumps, in capacities from 10 to 14,000 gpm, assures the pump that's tailored to *your* clear water moving needs — exactly. For full information, contact your nearby "Buffalo" Engineering Representative, or write for Bulletin 955-R.

Value Beneath the Surface . . . the impeller and shaft assembly of the "Buffalo" Double Suction Pump.



Water enters the efficient, enclosed impeller from both sides, to assure consistent hydraulic balance. All rotating elements are carefully-balanced prior to assembly. The value "bonus" in every "Buffalo" Pump is the "Q" Factor — the built-in QUALITY which assures trouble-free satisfaction and long life.



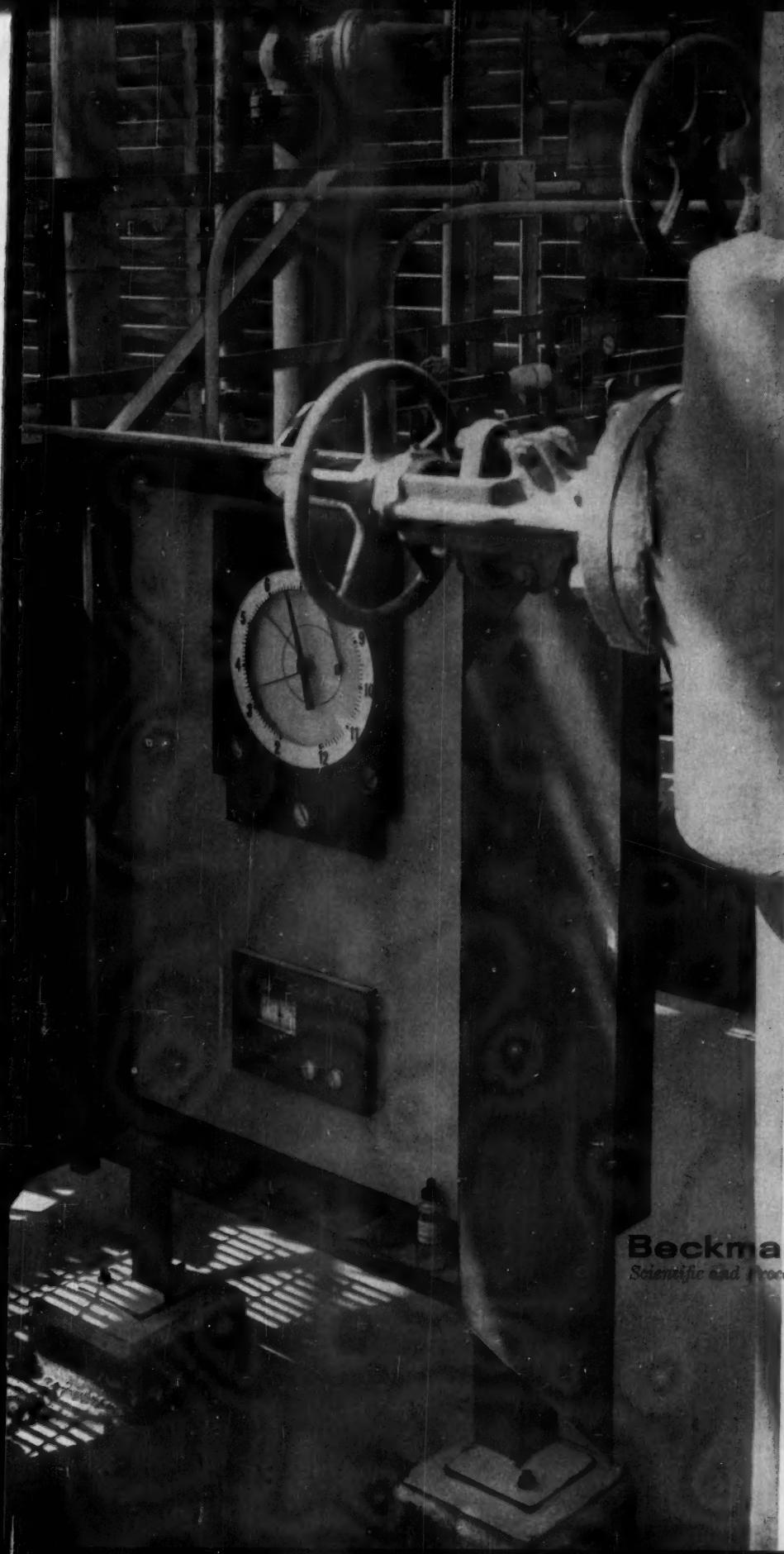
### BUFFALO PUMPS

DIVISION OF BUFFALO FORGE CO.

501 Broadway • Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.  
Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



**4 minutes' attention  
for 24-hour operation**

Just 4 minutes a day and a Beckman Model W Industrial pH meter are all it takes for a technician to prevent equipment corrosion by continuous pH control of cooling tower water at Collier Carbon and Chemical Corporation, Brea, California.

For over two years, this small Beckman pH amplifier has continuously maintained cooling water at a pH of 6, correcting all variations automatically in about 15 seconds. And, except for the few minutes attention required every morning for routine meter standardization, it has provided maintenance-free operation.

Beckman pH equipment can also give you dependability with minimum attention.

The reason: printed circuitry, plug-in assemblies, and ruggedized industrial electrodes.

Beckman makes and sells more industrial pH equipment than any other manufacturer in the world. Equipment and services are provided by leading recorder companies. For a list of these companies and instrument specifications, write for Data File P-2-14.

**Beckman**

*Scientific and Process*

*Instruments Division*

*Beckman Instruments, Inc.*

*2500 Fullerton Road, Fullerton, California*

*It's a Fact: More than  
500,000,000 hours have been  
logged by Beckman industrial  
pH meters...measuring  
and controlling pH  
in industrial processes.*



**ENGINEERS AND CONSTRUCTORS FOR INDUSTRY**

385 Madison Avenue

New York 17, N. Y.

## **LUMMUS AWARDED CONTRACT TO CONSTRUCT ACROLEIN UNIT FOR SHELL CHEMICAL CORP.**

### **Norco, Louisiana Unit Part of Shell's \$10 Million-Plus Expansion Program**

The Lummus Company has been awarded a contract to construct an acrolein unit for Shell Chemical Corporation at its Norco, Louisiana plant.

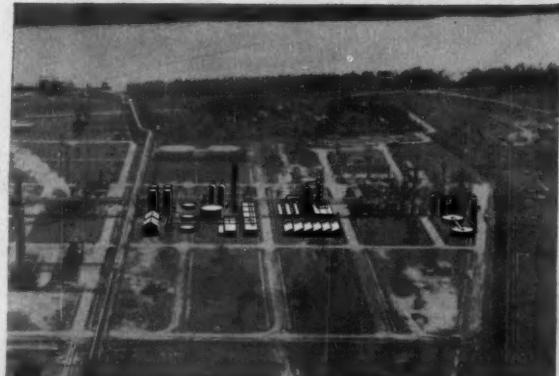
The unit, scheduled for completion late in 1959, is an important part of a program costing more than \$10,000,000, which will complete the remaining facilities in Shell Chemical Corporation's current production program at Norco.

The acrolein unit to be built by Lummus will help the Norco plant produce about 35 million pounds of glycerine a year plus substantial quantities of acrolein, a chemical not made in large volume until the development of the present process.

Shell believes that a wider availability of acrolein will lead to a greater variety of end uses for the product, such as plastics and resins, pharmaceuticals, and textile treating.

A second unit in the expansion program will make glycerine, using acrolein from the new unit and hydrogen peroxide from a unit which Shell completed earlier this year.

In addition to the new acrolein unit, other work done by Lummus for the Shell Chemical Corpora-



Artist's sketch shows relationship of new acrolein unit to existing plant.

tion includes EPON® Resin Units and a Bisphenol-A Unit at Houston, Texas.

For the design, engineering and construction of plants for the chemical industry, Lummus has over 50 years experience—on over 800 units for process industries throughout the world—to place at your disposal. Call Lummus on your next project.



**THE LUMMUS COMPANY, 385 Madison Avenue,  
New York 17, N. Y., Houston, Washington, D. C.,  
Montreal, London, Paris, The Hague, Maracaibo.  
Engineering Development Center: Newark, N. J.**

# Nichols Herreshoff

... flexibility plus

## for thermal Processing

### Standard Design

For drying, roasting, regenerating, dehydrating, etc. — where requirements are for a simple oxidizing atmosphere, permitting contact of combustion products with the charge.

### Indirect Firing

For applications when flame impingement upon materials under process is not desired. Fuel is burned in combustion chambers apart from furnace proper.

### Muffle Type

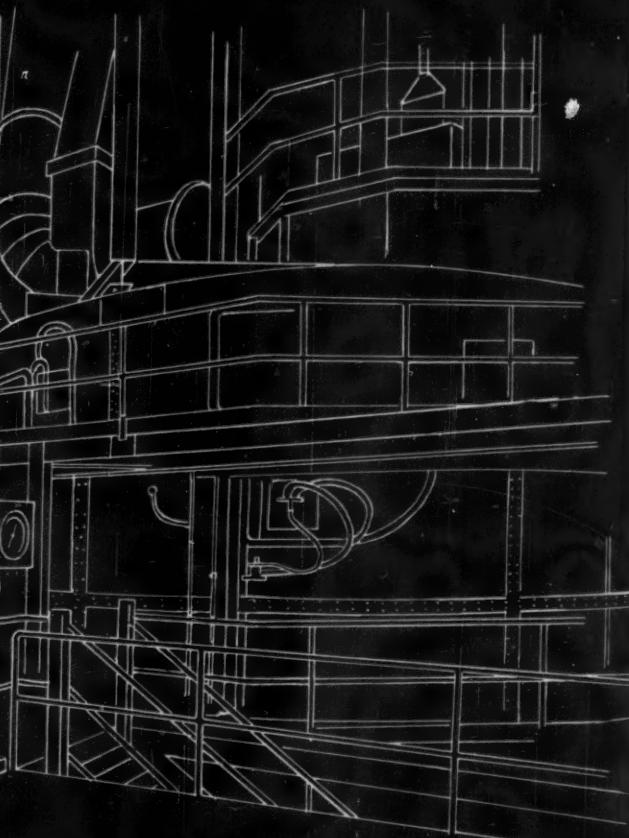
For applications where combustion gases must be kept separate from reaction products.

### Reduction Type

Excludes infiltration of air and permits reducing atmosphere in hearth spaces. Either solid or gaseous reductants can be used.

### Gas Recirculation

Provides added means for control of temperature and atmosphere. Combustion gases of very low oxygen content evolved without excessively high temperatures.



Whatever your process, whatever your product, if a thermal problem is involved, call in a Nichols engineer and let him show you the proved versatility of Nichols Herreshoff and Bethlehem Wedge furnace design.

Write for Bulletin No. 233

## NICHOLS ENGINEERING & RESEARCH CORPORATION

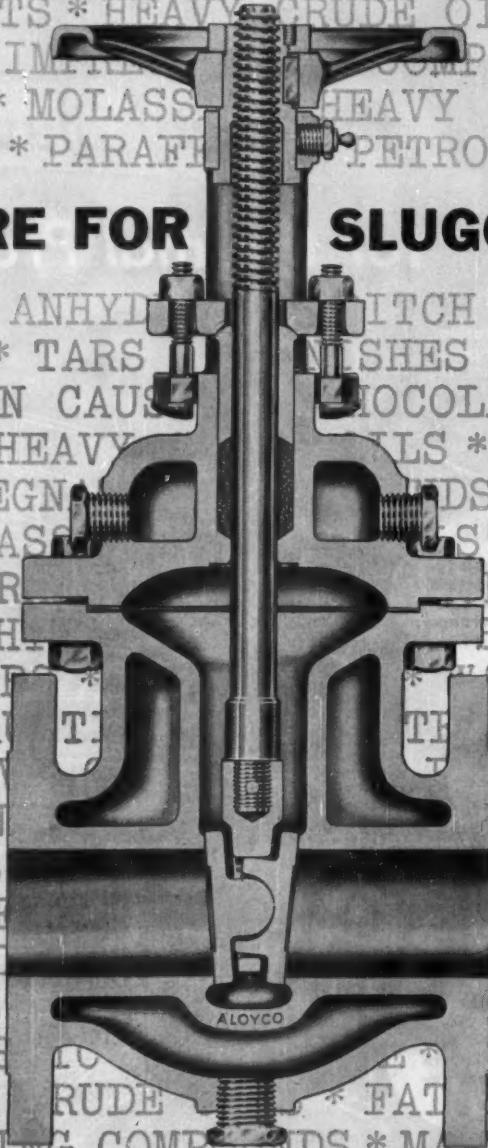
70 Pine Street, New York 5, N. Y.

405 Montgomery Street, San Francisco 4, Calif. 3513 N. Hovey Street, Indianapolis 18, Ind. 1477 Sherbrooke St. W., Montreal 25, Canada

ASPHALT \* MOLTEN CAUSTIC \* CHOCOLATE \* COAL TAR PRODUCTS \* HEAVY CRUDE OILS \* FATTY ACIDS \* GUMS \* IMPREGNATING COMPOUNDS \* MAELIC ANHYDRIDE \* MOLASSES \* HEAVY OILS \* HYDROGENATED OILS \* PARAFFIN \* PETROLEUM RESIDUES

## SURE CURE FOR SLUGGISH FLUIDS

\* PHTHALIC ANHYDRIDE \* BITCH \* SOAPS \* MOLTEN SULFUR \* TARS \* CHOCOLATE \* COAL TAR PRODUCTS \* HEAVY OILS \* FATTY ACIDS \* GUMS \* IMPREGNATING COMPOUNDS \* MAELIC ANHYDRIDE \* MOLASSES \* HYDROGENATED OILS \* PETROLEUM RESIDUES \* PARAFFIN \* SOAPS \* MOLTEN SULFUR \* WAXES \* ASPHALT \* MOLten CAUSTIC \* COAL TAR PRODucts \* FATTY ACIDS \* GUMS \* IMPREGNATING COMPOUNDS \* MAELIC ANHYDRIDE \* MOLASSES \* HYDROGENATED OILS \* PETROLEUM RESIDUES \* PHTHALIC ANHYDRIDE \* SULFUR \* TARS \* WAXES \* ASPHALT \* MOLten CAUSTIC \* COAL TAR PRODucts \* FATTY ACIDS \* GUMS \* IMPREGNATING COMPOUNDS \* MAELIC ANHYDRIDE \* MOLASSES \* HYDROGENATED OILS \* PETROLEUM RESIDUES \* PHTHALIC ANHYDRIDE \* SULFUR \* TARS \* WAXES \* ASPHALT \* MOLten CAUSTIC \* COAL TAR PRODucts \* FATTY ACIDS \* GUMS \* IMPREGNATING COMPOUNDS \* MAELIC ANHYDRIDE \* MOLASSES \* HYDROGENATED OILS \* PETROLEUM RESIDUES \* PHTHALIC ANHYDRIDE \* SULFUR \* TARS \* WAXES \* ASPHALT \* MOLten CAUSTIC \* COAL TAR PRODucts \* FATTY ACIDS \* GUMS \* IMPREGNATING COMPOUNDS \* MAELIC ANHYDRIDE



## COMPLETELY JACKETED ALOYCO VALVES

Aloyco Jacketed Valves are the surest way to keep slow moving corrosives flowing because they maintain higher temperatures than valves heated by other methods.

Jacketed valves are made in a variety of sizes and pressures and are furnished with convenient inlet and outlet holes for heating with steam or other media. They are available in 18 8S, 18 8SMO, Aloyco 20 and other analyses to specification.

The broad Aloyco Valve line includes Jacketed Gate (above) Globe and Check

Valves, the first Jacketed Valves ever integrally cast in high alloys. One more indication of Aloyco's leadership in pattern making, foundry techniques and engineering skills. Long experience in these areas has made Aloyco the world's foremost specialist in Stainless Steel Valves.

Ask Aloyco's Corrosion Engineering Service to work with you on your valve problems. Alloy Steel Products Company, 1801 West Elizabeth Avenue, Linden, New Jersey.



ALLOY STEEL PRODUCTS COMPANY

# Emery

## WEIGHING SYSTEM

# NEWS

### BIN, TANK AND HOPPER EDITION

No. 10

Covering design, development and application data on Emery Weighing Systems for industrial applications.

## ANNOUNCING THE NEW WAY-PAC\* LINE OF LOW-CAPACITY LOW-PRICE PACKAGED SYSTEMS FOR TANK WEIGHING

### SIMPLICITY OF SELECTION AND OPERATION IS KEY FEATURE OF SUPPLEMENTARY LINE

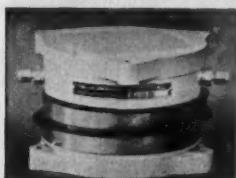


FIG. 1 TYPE AC-1 CELL COMPRESSION.

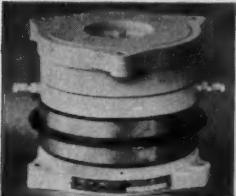


FIG. 2 TYPE AC-1 "ROLLING-BALL" CELL.

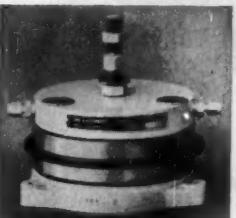


FIG. 3 TYPE AD-1 CELL DYNAMOMETER.



FIG. 4 TYPE AT-1 CELL TENSION.

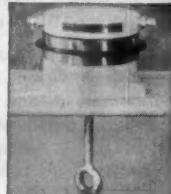


FIG. 5 TYPE AU-1 CELL TENSION.



**THE A. H. EMERY COMPANY**  
Pine Street • New Canaan, Conn.

### BIN, TANK AND HOPPER EDITION

No. 10

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## ANNOUNCING THE NEW WAY-PAC\* LINE OF LOW-CAPACITY LOW-PRICE PACKAGED SYSTEMS FOR TANK WEIGHING

### SIMPLICITY OF SELECTION AND OPERATION IS KEY FEATURE OF SUPPLEMENTARY LINE

The WAY-PAC, a new line of Emery low-capacity, low price packaged hydraulic tank weighing systems, designed specifically for the 0 to 1000 lb. range, is now being offered to the process industries.

The accuracy of the WAY-PAC cells is  $\frac{1}{4}$  of 1% of range. This extreme accuracy depends upon two significant design features . . . a moulded rubber diaphragm which maintains a constant acting area and a rolling ball assembly which performs the dual function of practically eliminating friction in the "piston-cylinder" assembly as well as preventing deleterious pinching of the diaphragm in the event of cross loading.

Five different cell types are available in the WAY-PAC line, each designed to perform with typical Emery excellence under different sets of operating conditions. (See Figs. 1 to 5).

The cells are manufactured of aluminum and a top grade bar stock steel to eliminate any possible leakage of the film of oil sealed in the diaphragm.

Unique design features, coupled with the ultimate in manufacturing craftsmanship, have produced in the WAY-PAC line equipment capable of long service life with extreme accuracy under the most rigorous conditions.

A complete line of related equipment is available including: tank pivots, strut assemblies, indicators and recorders. Although controlling and printing equipment can be supplied with and can be operated from the WAY-PAC cells, it is desirable that our engineers know the details of the installation in order to make a recommendation.

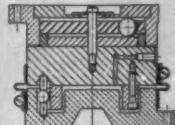
\*Trademark

#### Moulded Rubber Diaphragm Gives Constant Acting Area

The moulded rubber diaphragm used in the WAY-PAC cells possesses a unique "rolling action" which imparts constant acting area to the cell. This "rolling action" is illustrated in Fig. 7.

Because of this constant "rolling action", the Emery WAY-PAC load cell is extremely and consistently accurate.

#### Exclusive "Rolling Ball" Head Available in WAY-PAC LINE



To prevent damage from possible cross-wise movement of the tank, bin, hopper or structure being weighed, we have incorporated into the WAY-PAC cell line the exclusive "rolling ball" head.

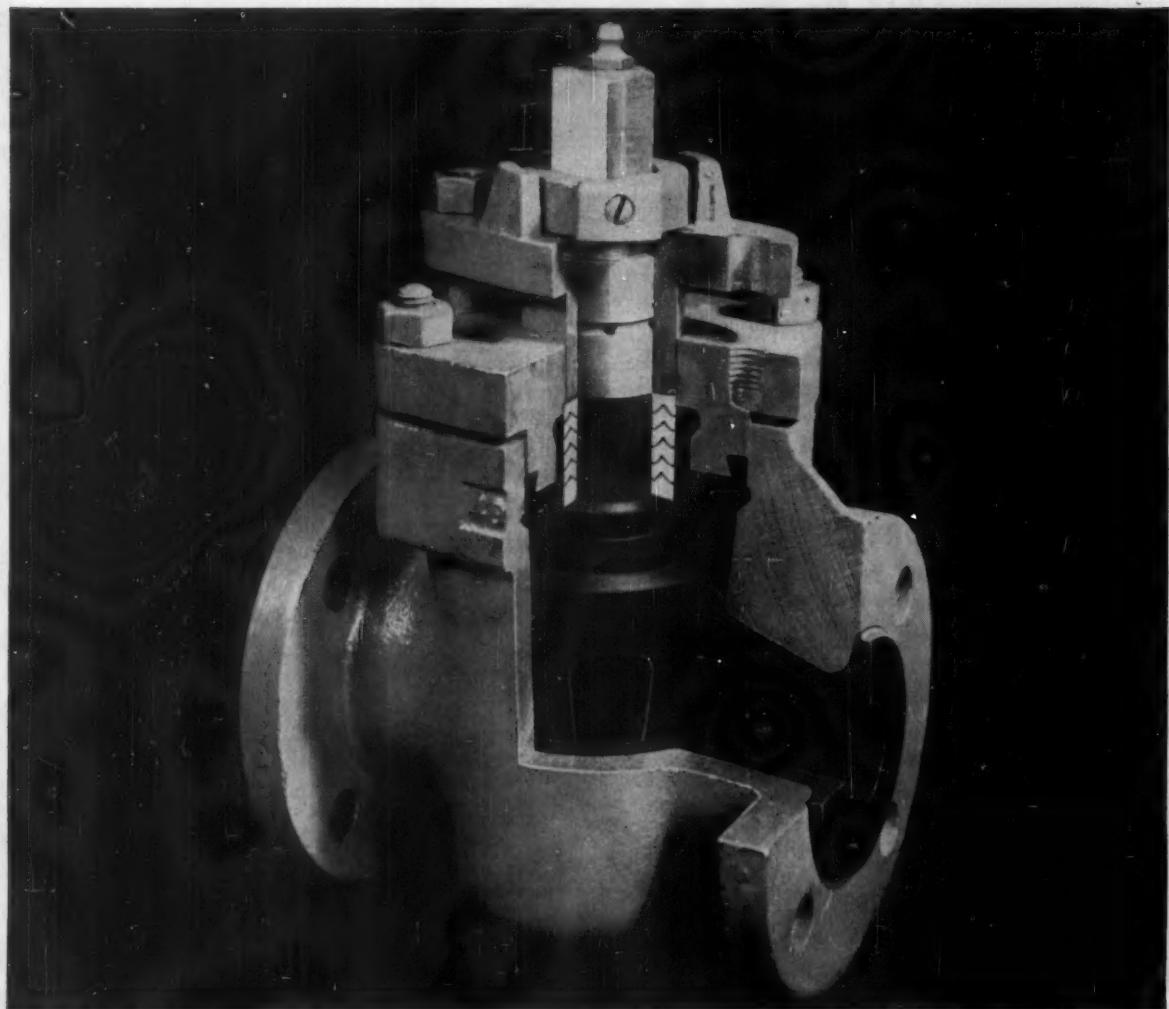
In essence, the WAY-PAC "rolling ball" head consists of three  $\frac{1}{4}$ " diameter stainless steel balls built into the top plates of the cell, riding top and bottom on hardened steel plates. (See Fig. 6). In operation, any cross-wise movement, such as that incurred in the expansion and contraction of the structure being weighed, rides on the stainless steel balls and is transmitted through them to the diaphragm.

Load cells which do not take expansion and contraction into consideration are not properly designed and cannot compare with the WAY-PAC.

#### NEW WAY-PAC BULLETIN 582 AVAILABLE FOR DISTRIBUTION

Our new Bulletin 582 which describes in detail the Emery WAY-PAC line and provides an easy-to-use method of figuring your system costs is now off the press. Send for your copy right away.





## You can see why Saran Lined Pipe costs so little per year of service

*Saran anchored within a steel casing safely  
conveys corrosive liquids for years of trouble-free service*

There's something special about this valve. It's saran lined and has a Teflon V-ring packing for easier opening and closing and more perfect sealing with less pressure. And yet, the fact that valves like this are stock items is another example of why saran lined piping systems are more economical to install.

Immediate availability of Saran Lined Pipe, valves, pumps and fittings means there's no waiting. And Saran Lined Pipe can be cut and threaded right on the job with conventional tools. This lower fabrication cost, combined with the long

life of corrosion-resistant saran, means that complete saran lined piping systems cost less in the long run.

Saran Lined Pipe with the new gray liner gives trouble-free service under operating pressures from full vacuum up to 300 psi and temperatures from -20° F. up to 200° F.

Send the coupon today to learn how you can save by installing a complete corrosion-free piping system with Saran Lined Pipe, valves, pumps and fittings. And be sure to ask about Saraloy® 898 tank linings. THE DOW CHEMICAL COMPANY, Midland, Michigan.

SARAN LINED PIPE COMPANY  
DEPT. 2003A-1  
2415 BURDETTE AVENUE  
FERNDALE 20, MICHIGAN

Please send me information on:  Saran Lined Pipe, fittings and valves  Saran lined centrifugal pumps  Saraloy 898 chemical-resistant sheeting

Name \_\_\_\_\_ Title \_\_\_\_\_ Company \_\_\_\_\_

Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_

YOU CAN DEPEND ON



December 1, 1958—CHEMICAL ENGINEERING



## An Electrical Engineer comes to CROUSE-HINDS for the "Latest Dope" on Explosion-Proof Electrical Equipment

"Charlie," says the visiting engineer, "I'm looking for the latest and best in explosion-proof electrical equipment for our new petrochemical plant.

"We'll have a variety of hazards that will hit every Group under Class I of the National Electrical Code.

"I'm here to find out what you've got that meets our specifications."

"Well sir," says Charlie, "before we get into specs, I'd like to go to fundamentals for a minute.

"You don't need to be told that physical laws are unbreakable. Try to break them . . . and they break us. Just *flirt* with them and we get slapped.

"At Crouse-Hinds we treat those laws with great

courtesy. We respect them in the very smallest particulars of design, construction and application . . . in every piece of explosion-proof equipment we build.

"That's what the National Board of Fire Underwriters and similar organizations are looking for when they classify every Class and Group in such detail. And that's why they like to see compliance with those requirements in the hands of competent engineers like yourself."

"Charlie, with what's at stake, I have to be competent . . . or else."

"And we're here to help out with the right equipment . . . made exactly for the job you have to do . . .

more →



## "First off, let's look at the fundamentals of explosion-proof construction."

"Take this OFC Switch Condulet\* for example . . . It incorporates all the basic features of Crouse-Hinds explosion-proof construction. The casting is of Feraloy . . ."

"What's that?"

"Feraloy is a special alloy that combines the desirable characteristics of both cast steel and gray iron. It's strong, tough, homogeneous. It machines well and forms full threads."

"How is it on corrosion? We'll get a lot of that."

"Feraloy itself is alloyed for corrosion resistance. In addition, it is triple-layer finished on all surfaces."

"The casing thickness is *four times* stronger than the maximum needed to contain any possible explosion of gas or vapor, without rupturing."

"How about leakage around the threads?"

"These threaded joints are flame-tight. And right there you've got an important extra: For Group C and D locations, UL calls for a minimum of *five* threads to insure cooling of escaping gases. We give you *seven* threads . . . on every threaded joint of explosion-proof Condulets."

"This means if somebody forgets to make a joint or cover 'wrench-tight', chances are *still* very high of having at least five threads fully engaged."

"Good point, Charlie."

"One more thing about threads. Condulets are *taper-tapped* to match conduit threading, and give you tight, rigid joints throughout the system. And there's a deeper recess for complete tightening without bottoming on the integral bushing."

"What about seals?"

"Whenever practical, Condulet explosion-proof equipment is factory-sealed. Wherever it's not, we have a big selection of seals, breathers and drains to choose from."

"Wish it were physically possible for you to factory-seal everything, Charlie. Everybody would feel safer, I'm sure. O.K. . . . what's next?"

\*CONDULET is a coined word registered in the U. S. Patent Office. It designates a brand of products made only by the Crouse-Hinds Company.



## "Superior design begins where it should ...with your needs."

"This new EWC Control and Indicating Station is a good example.

"Here is a type of control that is located outdoors as often as not. Because of this, we have designed it to be water-tight . . . as well as explosion-proof and dust-ignition-proof. It will take hurricane rains — or direct streams of water in washing-down operations — without breaking the Neoprene O-Ring seals at cover, shafts and pilot light jewels."

*"Aren't those threaded covers?"*

"Threaded covers, threaded operating shafts, and threaded pilot light cover — which is a new

development for this type of device. And it includes all the other features we looked at in the OFC a little while back.

"It's versatile, too . . . available with pilot lights, heavy-duty pushbutton stations, selector switches . . . in various combinations . . . and in single, double or triple gangs.

"The EWC shows particularly well that good design is the sum of a great variety of things, big and small, depending on the job a device has to do. But they're all pointed toward giving you explosion-proof equipment that's safer, easier to install and operate, longer lasting, and *tuned to your needs*. That's true of the EWC . . .

## "...or this explosion-proof Arktite\* Plug and Receptacle."

"This Arktite is quite a work of art in its way. It conforms to UL test requirements throughout. You can make or break contact at full load *without* disconnect switches."

*"No flashover?"*

"Flashover is impossible. Each contact is insulated in a separate chamber. All arcs are snuffed out by pressure-deionization and lack of oxygen."

*"Swell . . . but how about the grounding?"*

"The male grounding contacts are *longer* than load contacts . . . so the plug shell and tool are grounded *before* power circuit is made and remain grounded until *after* it's broken. Chances for human error are practically zero with the Arktite."

\*Registered



## ***"Charlie, we can't afford to overlook anything that needs to be explosion-proof."***

*"Can we get everything we will need from you?"*

"Yes. Our ads say we have the 'world's broadest line' of explosion-proof electrical equipment. That's really true.

"Take the items in this display: Most of them are Condulets. There are more than 15,000 items in just that one line . . . everything from junction boxes to process control centers . . . in explosion-proof, dust-ignition-proof, or conventional construction.

"Just to show how complete the explosion-proof part of the line is, here are all kinds of warning lights, horns and sirens . . . even exit signs."

*"One of our most important needs in the new plant is communications. What have you got there, Charlie?"*

"Well, here's a choice of manual, dial and magneto type telephones for desk use, or for wall or panel mounting for use on common or local battery systems."

*"How loud can you set the bell for our noisy spots?"*

"You can have auxiliary bell or horn signals set to wake up a hibernating bear, if you like."

"Now here's something you might need in your search or quality control setup — instrument Condulets to provide enclosures with glass fronts for meters, gauges, and so on. And here are photo-electric Condulets for colorimetry, counting, or automatic control."

*"We'll need plenty of that."*

"Then there's lighting. Name the kind and amount of light you need . . . incandescent or fluorescent, desk, bench, area or flood . . . and Crouse-Hinds has it."

"We're pretty proud of our new EVA Mercury vapor fixture which makes mercury vapor advantages available in hazardous areas: 2.5 times more light, and seven times longer lamp life than incandescents."

*"Terrific. Anything that cuts the frequency of replacing lamps in hazard zones is welcome!"*

*"But Charlie . . . making all this approved equipment available to you must have a UL man on hand most of the time."*

*"That's right . . ."*



Panelboards



Plugs and Receptacles



Flexible Couplings



Instrument Enclosures



Process Control Board Components



Pilot Lights



Switches



Lighting Fixtures



Fixture Hangers



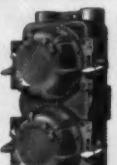
Control and Indicating Stations



Unions



Seals



Motor Starters and Circuit Breakers



Signals, A

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## "With UL-listed equipment in every Class and Group, we work very closely with the UL inspector-in-residence."



Switches



Breathers and  
Drains



Communication Equipment



Signals, Alarms



Fittings



Junctions

"This is his office right here. A senior Crouse-Hinds engineer has the full-time job of Underwriters' Laboratories Coordinator. Under his guidance, our engineering staff carries out UL requirements on product development . . . and on design modifications that are made to meet customer specifications.

"Actually, every classification of UL-listed equipment we make is checked by the UL inspector-in-residence.

"In a petrochemical plant like the one you're building, you're certain to have Group A and B locations, with hydrogen and perhaps acetylene present. We have approved equipment for A and B areas.

"You may have some hazardous dusts around, too . . . resins or coke or magnesium, and so on. If so, we can supply UL-listed dust-ignition-proof electrical equipment for every Group under Classes II and III, also.

*"Looks like you've got the whole ball of wax on products, Charlie. Anything else?"*

"There sure is — Crouse-Hinds Field Service . . .

more →



## "Customers say the only thing better than our products is the help you get from our field engineers."

"I'd like you to meet one who just flew in to work out some customer specs and delivery timetables. I hope he won't be embarrassed if I tell you what makes him tick.

"First of all, he's an Engineer. He's had an extended period of in-plant training in all departments. He has handled just about every kind of hazard problem and recommendation you can think of. He can help analyze your needs, and recommend the safest, most economical equipment for specific applications.

"He has know-how . . . backed up by plenty of know-why. He knows where the hidden probabilities of explosions do their hiding. He knows the various degrees of hazard . . . which means he knows where you can afford

to save money by installing equipment adequate for Division 2 conditions.

"He knows what you have at risk in lives, plant, equipment, materials and inventory. And he's completely oriented to giving them the best possible protection at the lowest possible cost . . . without ever flirting with those physical laws we were talking about.

"There are 85 more field engineers like him on our staff. And I know you'll enjoy doing business with any one of them. O.K.?"

*"Well, Charlie . . . all I can say is if that's the service that comes with the product, I'm sold on Crouse-Hinds!"*

If you have a hazardous-area problem, why not call in your nearest Crouse-Hinds Field Engineer for practical, down-to-earth suggestions? In the meantime, send for our Catalog No. 3400, containing detailed descriptions and specifications on Crouse-Hinds Explosion-Proof Electrical Equipment.

# CROUSE HINDS

MAIN OFFICE AND FACTORY: SYRACUSE, NEW YORK

Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

Crouse-Hinds Instrument Company, Inc., Silver Spring, Maryland

• CONDULET® ELECTRICAL EQUIPMENT (Explosion-Proof and Conventional) • FLOODLIGHTING

• TRAFFIC CONTROL SYSTEMS • AIRPORT LIGHTING and WEATHER MEASURING EQUIPMENT

These products are sold exclusively through electrical distributors. For application engineering help, contact one of the following offices: Atlanta, Baton Rouge, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Corpus Christi, Dallas, Denver, Detroit, Houston, Indianapolis, Kansas City, Los Angeles, Milwaukee, New Orleans, New York, Omaha, Philadelphia, Pittsburgh, Portland, Ore., St. Louis, St. Paul, Salt Lake City, San Francisco, Seattle, Tulsa, Washington, Reading, Pa., Richmond, Va.

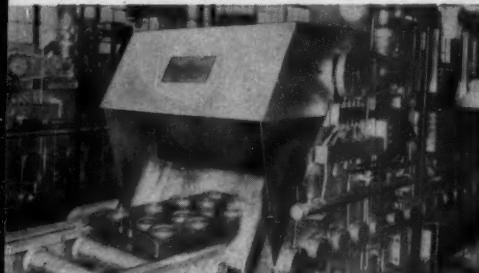
Representatives: Albany, Baltimore, Charlotte, Chattanooga, Reading, Pa., Richmond, Va.

A word to the refractory-wise:

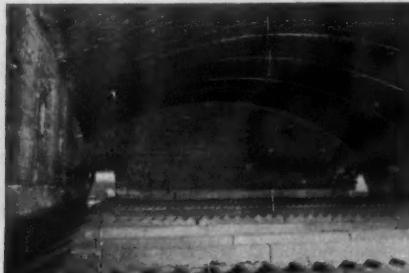
# The recession is fading fast... are you ready for the rebound?

Industry is on the move again. But management has learned valuable lessons from the recession. In the future they will exercise extremely *close* control of costs. To satisfy this sharp-eyed attitude, unit costs and prices must be brought down to a rock-bottom low. So make sure *your furnaces* can help cut production costs. Make sure your furnaces are ready *now* to operate at peak efficiency during the months to come.

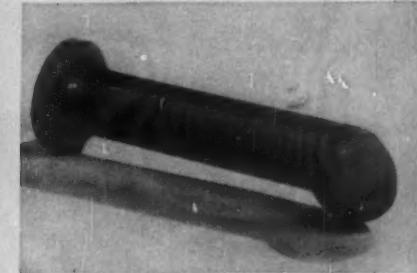
Consider the "vulnerable" areas in your furnace, for example — areas subjected to flame impingement or heavy loads, or exposed to abrasion or corrosion. Or other working areas where heat must pass *through* the refractory. These are the areas where you can substantially cut production costs — particularly if you use one of our special-purpose Super Refractory materials. The three examples on this page show how *large* these savings can be.



**LAST 5 TIMES AS LONG.** In this high temperature atmosphere furnace, parts travel through on a cycle from cold to 2100°F to cold in 1 hour and 10 minutes. Metal fixtures warped, stuck to parts. Thicker fixtures absorbed furnace heat. Super Refractory fixtures outlasted the alloy 5 to 1, cut weight, ended sticking, and cost less as well.



**STOP ALL MAINTENANCE FOR 2 YEARS.** Notches in this walking beam furnace lasted 4 to 6 months, and furnace had to be shut down almost weekly for repair on the notches (on which bars being heated rest). When Super Refractory rests were installed, the furnace ran for 2 years without any repair at all, and ran another year with only 10% replacement. Cost? Less than half that of alloy.

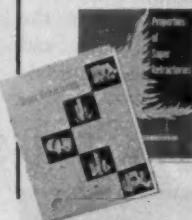


**HANDLES CHEMICAL ATTACK FOR 5 YEARS.** This nozzle sprays 150°F acid into an absorbing chamber where gases are at 1800°F. This Super Refractory easily withstands this tough combination of both corrosion and sharp temperature gradient, and lasts over 5 years, compared to 2 months for metal.

## CARBORUNDUM

Registered Trade Mark

### HERE'S HOW YOU CAN START CUTTING COSTS:



It will take less than an hour to read these two booklets about the applications and properties of Carborundum's unique, new super refractories. Send for them today, to Refractories Div. Carborundum Company, Perth Amboy, N. J., Dept. H-128.



SPROUT-WALDRON

# Pointers

for Mixing and Blending • Size Reduction  
Size Classification • Bulk Materials Handling • Pelleting and Densifying

Published in the interest of better processing by Sprout, Waldron & Co., Inc., Muncy, Penna.

## Production and Quality up with Single Runner Attrition Mill



The use of a 36" swinghead, single runner attrition mill at The Garlock Packing Company, Palmyra, New York is reported to have increased production, lowered costs and improved quality.

The asbestos fiber at The Garlock Packing Company is used in the production of textile yarns and cloth which become base materials

*Fiberizing asbestos by means of Sprout-Waldron single runner attrition mill speeds production, ups quality, cuts waste.*

for mechanical packings, gaskets and compressed asbestos sheet. Fiberizing equipment previously used consisted of a roll crusher, a vertical opener, and a willow used in conjunction with a ceiling con-

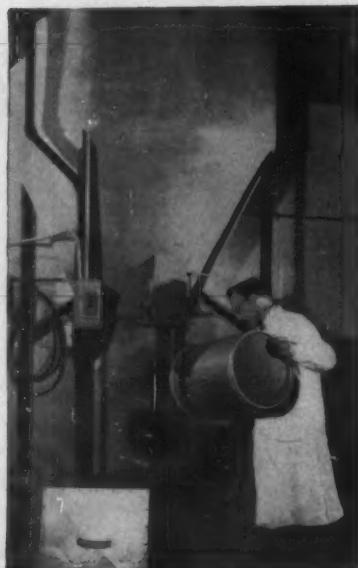
denser. The Sprout-Waldron 36" swinghead single runner attrition mill which replaces these units is simple and compact by comparison.

The following advantages have been noted:

1. The fiberizing and blending of milled asbestos have been improved.
2. Production rate has been increased.
3. Separation of short fractions of asbestos has been reduced, thus minimizing waste.
4. Simple adjustments on the attrition mill plates permits flexibility, whereas fiberization with the old equipment could only be controlled by the rate of feed.
5. Semi-crude blue asbestos is fiberized in one pass through the attrition mill. Previous methods required two passes.

SW

## POLYCARBONATE RESIN BLENDED IN STAINLESS STEEL MIXER



*Stainless steel jacketed vertical mixer being fed through table high hopper at General Electric Company's Chemical Development Department in Pittsfield, Massachusetts.*

Uniform blending of polycarbonate resin at the General Electric Company's Chemical Development Department plant in Pittsfield, Mass., is being accomplished in a special stainless steel 50 cubic foot vertical mixer. The 10' 10" high, 60" diameter vertical mixer is jacketed for 14.7 psig steam pressure.

The product to be blended is trade named, "Lexan". It is a special polycarbonate resin molding compound developed by the General Electrical Company to provide unusual toughness and heat stability. The mixer's job is to blend this resin while in  $\frac{1}{8}$ " chopped rod pellet form just prior to packaging.

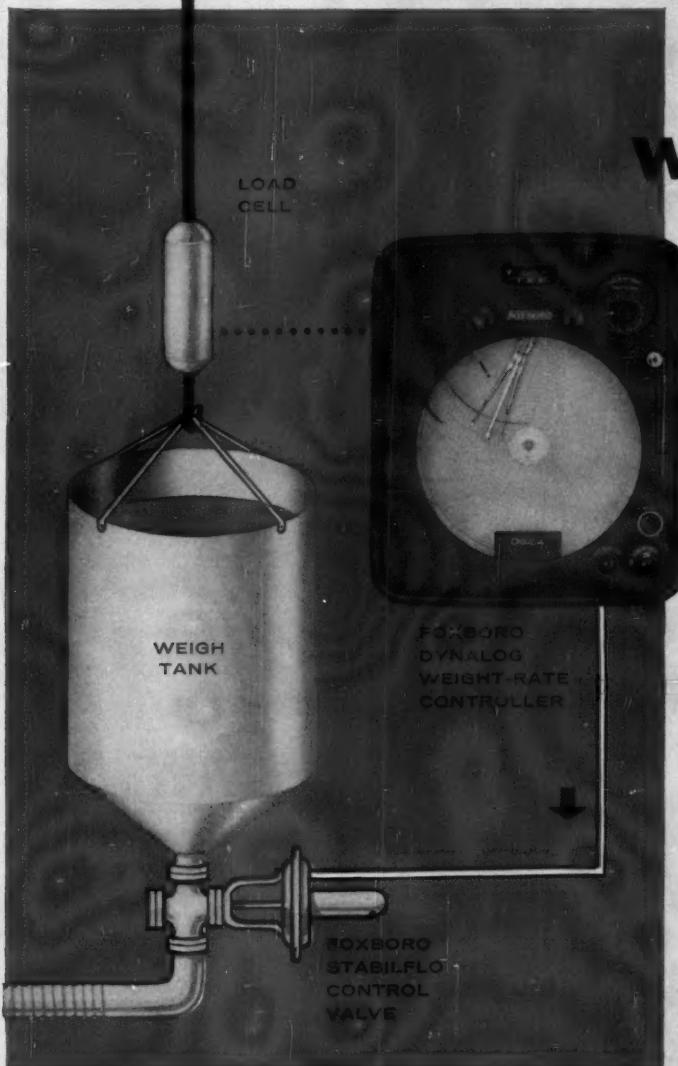
In designing the mixer, four major problems had to be overcome. The material had to be kept warm during processing; floor space was at a premium; excessive attrition had to be avoided; and it was de-

sired to feed the mixer from the ground floor.

The use of a steam jacket on the mixer solved the problem of keeping the material warm during processing. The selection of the Sprout-Waldron vertical mixer design took care of the floor space requirements. This 50 cubic foot capacity mixer, including the table height loading unit requires less than 15 square feet of space.

Tests were conducted to find the optimum motor speed to assure thorough blending with a minimum of attrition . . . and ground floor feeding was achieved by the design of the mixer which receives its support from four vertical legs attached to the sides of the cylinder. The hopper is centered just about table top level for convenient feeding. The forced feed-in screw and elevating section below the mixing cone offers maximum efficiency.

problem of  
metering "tricky" liquids  
eliminated!



**HOW IT WORKS** The Foxboro Weight-Rate Flow Control System controls weight of liquid passing from a weigh tank suspended from a load cell (either hydraulic or strain gauge-type). Cell continuously measures decreasing weight of liquid. Controller records weight, controls time of draining, and sends pneumatic control signal to a Foxboro Stabiflo Valve installed in drain line. After correct amount of liquid is taken from tank in the desired time, controller automatically closes valve.

## Foxboro WEIGHT-RATE SYSTEM

accurately controls flow rate  
of any liquid that will  
pass through a pipe

Here's a Foxboro batch control system designed especially for liquids that undergo wide fluctuations of density or viscosity, or for liquids at high temperatures. Small volumes, corrosive liquids — even liquids that stick to the side of a tank will not affect the system's accuracy.

The Foxboro Weight-Rate System controls flow rate by weight of liquid rather than by volume. Functions of a load cell; a Dynalog\* electronic recorder; and a Cyclelog\* pneumatic controller are coordinated to do this.

Operation is simple. You merely set weight of liquid, dial the desired time, and push a button. The automatic control system does the rest, while keeping an accurate record of the whole process.

Best of all, the Foxboro Weight-Rate System requires practically no maintenance. That's because neither the measuring element nor the controller ever come in contact with the process liquid.

If batch operations with "tricky" chemicals are your problem, Foxboro has the answer. Call your local Foxboro Field Engineer for full details, or write The Foxboro Company, 3812 Neponset Ave., Foxboro, Mass.

\*Reg. U.S. Pat. Off.

**FOXBORO**  
REG. U.S. PAT. OFF.  
FLOW CONTROL SYSTEMS



An operator in the Saran Process Laboratory of the Midland Division of The Dow Chemical Company loads material into a Stokes Vacuum Shelf Dryer. This unit is equipped with nine, 24" x 36" drying shelves . . . and provides 3" free clearance between shelves.

## Dow chooses Stokes Vacuum Shelf Dryer for Saran Laboratory

The new Saran Process Laboratory of the Midland Division, The Dow Chemical Company (Midland, Michigan), has installed a Stokes Model 238-F Vacuum Shelf Dryer. This equipment is being used for drying a variety of resinous products on a laboratory and developmental scale. This particular model was furnished as a complete package, including a Stokes 9KW electrically heated hot water system with temperature range of 80 to 210° F.

Stokes Vacuum Shelf Dryers enable the safe drying of heat or air-sensitive materials which must remain dormant during processing. Units are available for heating by hot water, steam or heat transfer liquids.

Fabrication is from ASME Code-inspected materials — by ASME Code-certified welders — with final inspection according to ASME Code. All manifold connections are made outside the chamber, eliminating any risk of product contamination by internal leakage. Major components for a variety of shelf drying systems are stocked — for fast delivery, while meeting individual customer requirements.

Stokes produces rotary vacuum dryers, rotating vacuum dryers, vacuum shelf dryers, drum dryers and flakers, tabletting equipment . . . maintains a complete laboratory to provide expert application assistance. Write Stokes, or contact your nearest Stokes office for complete information.

Vacuum Equipment Division  
F. J. STOKES CORPORATION  
5500 Tabor Road, Philadelphia 20, Pa.

**STOKES**



Tidewater Oil Company's 200 million dollar refinery near Wilmington, Delaware. Six of its eleven processing units are largest of their types ever built!

## SQUARE D CONTROL CENTERS

serve New

## TIDEWATER REFINERY

*Here's Why Square D is Your Logical Choice, too!*

**INCREASED SAFETY!** • Bus bars fully enclosed, rigidly supported and have ample cross section. Circuits isolated by individually enclosed plug-in units. Disconnect handle gives maximum operator protection.

**FLEXIBILITY!** • Individual plug-in units or complete sections easily added, removed or exchanged. Pushbuttons, pilot lights, and selector switches readily added to unit doors.

**INSTALLATION ECONOMY!** • All wiring channels are large and accessible from front without removing units. No "wire fishing."

**SPACE ECONOMY, TOO!** • Up to six combination starters fit in a 20" x 90" section. Plug-in unit heights designed in space-saving increments of 3".

**SUPERIOR DESIGN** you can actually see and feel. Practical, modern styling. Greater structural strength gives more rigidity and assures precision alignment.

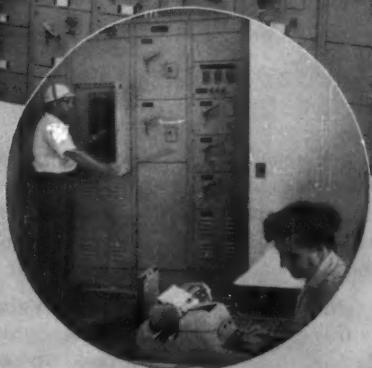
*Write for CONTROL CENTER BULLETIN...*

Square D Company, 4041 N. Richards St., Milwaukee 12, Wis.

**EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE**



**SQUARE D COMPANY**

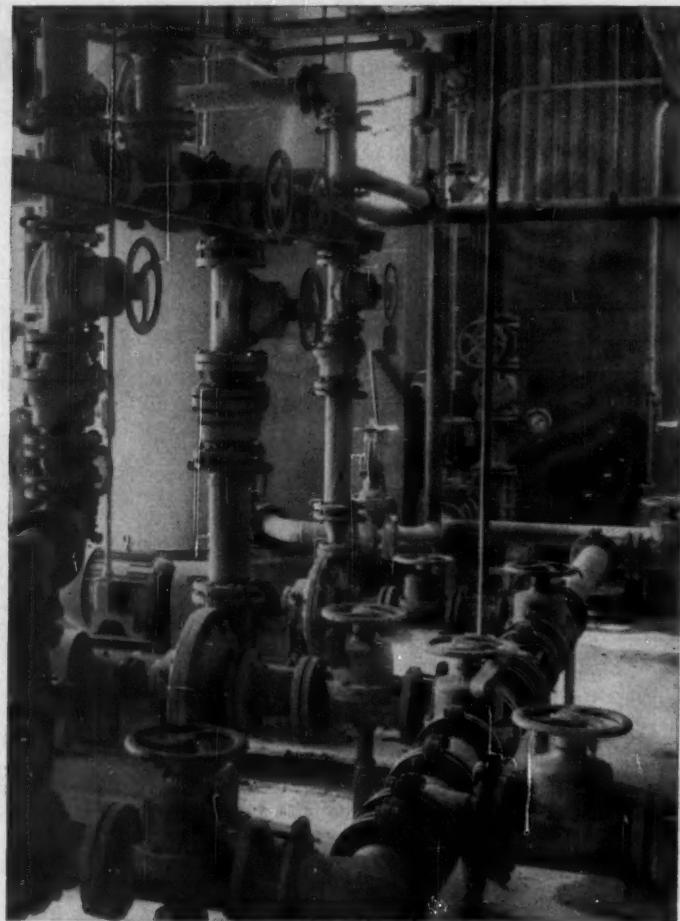


(Top photo) In the refining area Square D Control Centers provide a portion of the centralized control of pumps and compressors. In the maintenance shop they control power, heating, ventilating and lighting.

(Lower photo) Another Square D Control Center, located in the Employee Relations Building, provides pushbutton control of air-conditioning units and compressors. Infirmary X-Ray equipment and parking lot lighting also are remotely controlled from this Center.

# Maintaining maximum flow in serum lines with minimum pressure drop

Goodyear Tire & Rubber Company reports no valve clogging or interruption to flow in handling viscous fluids — with Grinnell-Saunders Straightway Diaphragm Valves.



Grinnell-Saunders Straightway Valves are now in use on serum lines of the Goodyear Tire & Rubber Company. Serum is a suspension of rubber particles in an acid brine solution. The installation pictured above is in Goodyear's Synthetic Rubber plant at Houston, Texas.

Grinnell-Saunders Straightway Valves were selected for this service because of their straight-through design. Material in process cannot build up and choke off flow because there are no pockets or gate trenches to trap solids. The straight-through feature also assures speed, ease and economy of rodding out, when necessary. When a diaphragm must be replaced — that job, too, can be done quickly, without removing the valve body from the line.

Isolation of operating parts from the fluid stream is still another important advantage of the Grinnell valve . . . eliminating corrosion and clogging of the valve

mechanism while, at the same time, preventing contamination of product in the line.

Grinnell-Saunders Diaphragm Valves are available in a wide range of body, lining, and diaphragm materials to meet different service conditions. To secure further information, contact the Grinnell branch office nearest you — or write directly to Grinnell Company, Inc., 277 West Exchange Street, Providence, R. I.



Diaphragm lifts high for streamlined flow in either direction. No irregular surface to trap deposits.



Diaphragm presses tight for positive closure, even when handling viscous or fibrous materials.

## GRINNELL-SAUNDERS DIAPHRAGM VALVES



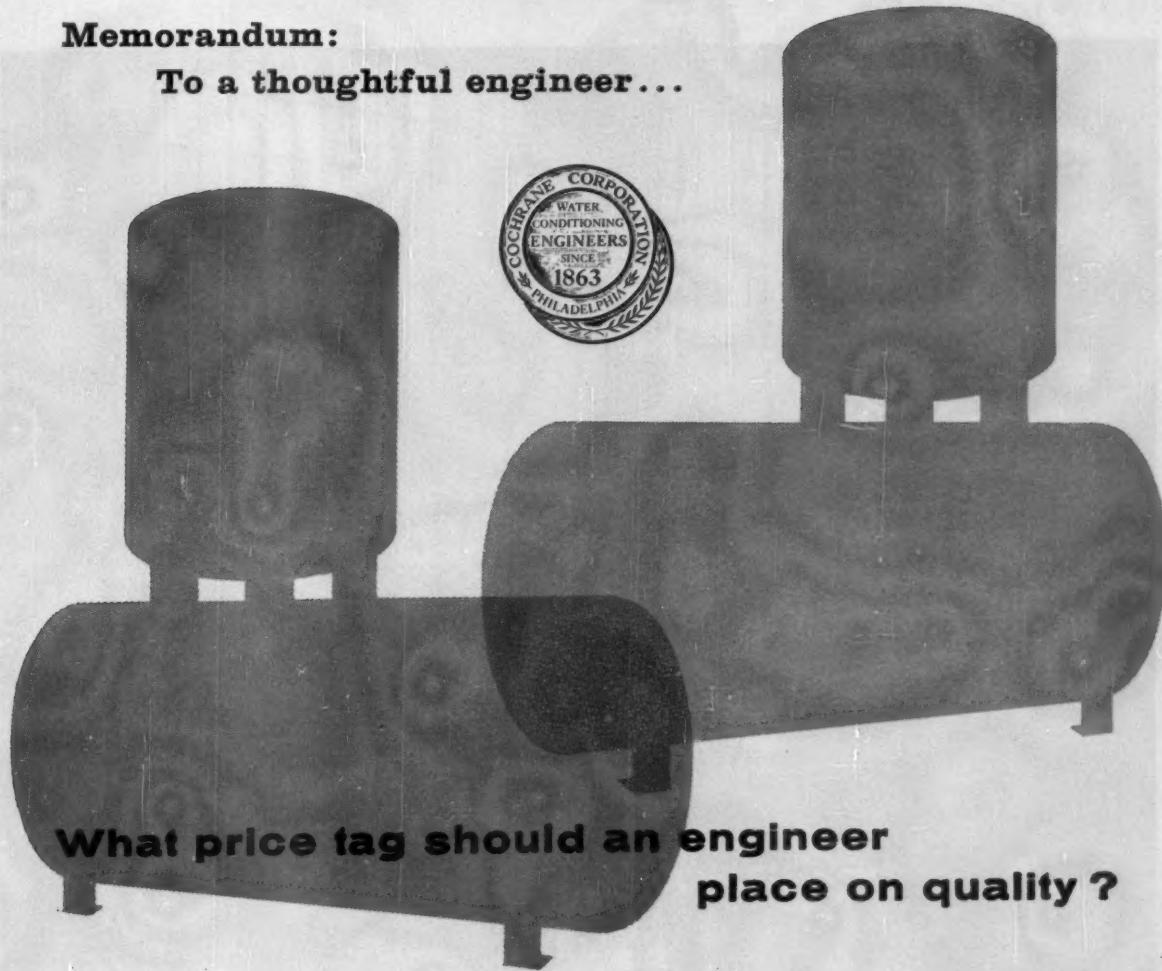
Grinnell Company, Inc., Providence, Rhode Island

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves  
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies  
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Coast-to-Coast Network of Branch Warehouses and Distributors

## Memorandum:

To a thoughtful engineer...



### What price tag should an engineer place on quality?

These two medium sized deaerators look alike. We designed both. They have the same outlet capacity, carry similar guarantees and meet the ASME code. But one costs \$2000 more than the other.

Which is the better buy?

Obviously, you would want to know more about each unit in order to make a sound decision. Construction to ASME standards and basic guarantees are but part of the quality story. The higher priced unit, for example, has far heavier shell plate, more tray area and spilling edge, superior shell reinforcement, stainless instead of carbon steel baffle, anti-flash downtime. All of these features, we have found, are important to continued top performance.

As one of the world's largest and most experienced manufacturers of deaerators, we believe we know which unit is the better buy. Extra margins of strength and capacity—wisely selected—are not luxuries but sound investments that eliminate downtime and expensive field repairs.

That is why we recommend *quality*, and why thoughtful engineers insist on *quality*. If you are considering the purchase of deaerating equipment we are prepared to help you evaluate all the features that mean *true economy* in service. Ask for Bulletin 4650 on the "Why and How of Deaeration".



Write for these five bulletins on Deaeration—the problem, types of deaerators and applications.

## Cochrane CORPORATION

3113 N. 17th Street, Philadelphia 32, Pa.

Philadelphia • New York • Chicago

Cochrane Water Conditioning, Limited, Toronto, Montreal, Winnipeg, Canada.

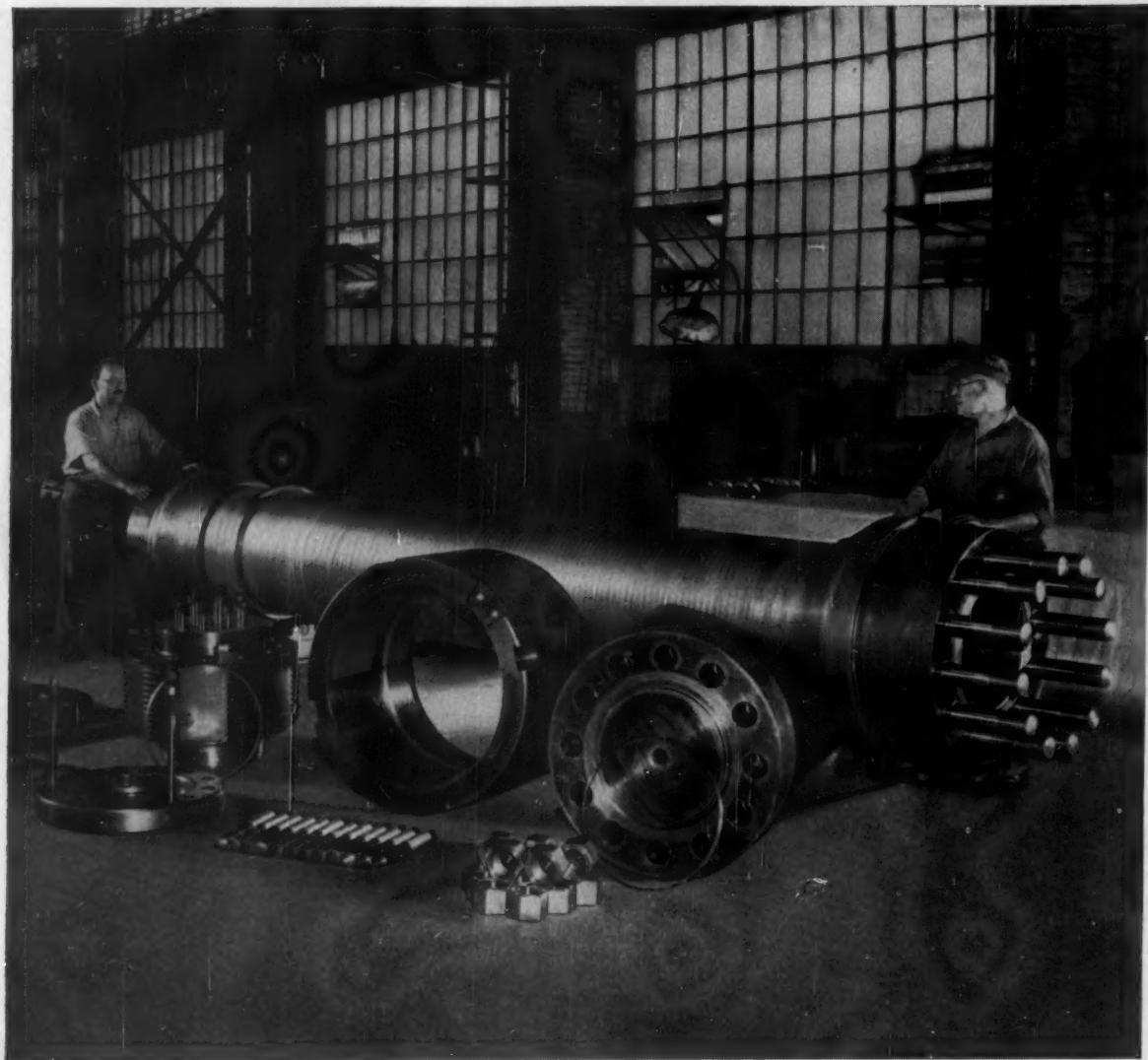
Demineralizers • Zeolite Softeners • Hot Process Softeners • Hot Lime Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Pressure Filters

Continuous Blowoff Systems • Condensate Return Systems • Steam Specialties

Representatives in thirty-two principal cities in U.S., Hawaii, Puerto Rico; also Havana, Cuba; Paris, France; La Spezia, Italy; Mexico City, Mexico; Caracas, Venezuela; Santiago, Chile.

### POTTSTOWN METAL PRODUCTS DIVISION—

Custom built carbon steel and alloy products.



## Closely Machined to Contain High Pressures

As pressure vessels go, this is a relatively small one—just 14½ tons fully assembled. But it contains literally scores of parts, some of which required elaborate machining.

After we had made the steel and done the necessary forging and treating, our machinists took over. Most of the tolerances were small, yet every specification was met in full. Under hydrostatic test, the vessel "proved out" perfectly.

At Bethlehem, machining is done as carefully—and capably—as the vital preliminary steps.

Thus a completed Bethlehem vessel always has the snug, tight-fitting parts so essential in pressure work. Call us when in the market for fully machined converters, reactors, separators, filters, autoclaves, accumulators. We build them in a complete range of sizes up to 150 tons or more.

**BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.**

*On the Pacific Coast Bethlehem products are sold by*

*Bethlehem Pacific Coast Steel Corporation.*

*Export Distributor: Bethlehem Steel Export Corporation*

**BETHLEHEM STEEL**





## ONE OF A SERIES

Printed by offset lithography on 70-lb. paper containing Wyandotte PURECAL® in the coating.

# Can Wyandotte technical service save money for you?

Because of the diverse areas of Wyandotte's technical-service activities, savings to customers are sometimes difficult to pinpoint and project.

Ofttimes no saving at all is effected. But in almost every instance a valuable service is performed.

For example, take the application of a new three-stage bleaching operation that Wyandotte technical service helped to develop in a paper mill. It enabled the mill to get fibres from waste paper fully equal to virgin pulp.

Or, take the case of a salt manufacturer whose problem was solved with special handling equipment—recommended through our technical service.

Or, the case of a detergent maker who sought and received a surfactant with lower foam characteristics, making possible an improved product.

All helpful services, but impossible to measure in terms of savings.

Contrast these examples with the experience of a famous brewery where Wyandotte technical service recommended a change to liquid caustic . . . which resulted in savings of from \$26,000 to \$52,000 annually in caustic costs.

The big point is: The primary purpose of Wyandotte technical service is to help our customers use our products to the best advantage in their operations. This we do.

That we are able at the same time to effect savings for customers is further evidence that our technical service is deep-rooted and sincere.

If you want to put Wyandotte to work for you, or if you want technical data on Wyandotte products, contact our nearest representative . . . or drop us a line, giving as many details of your request as possible.

For a pictorial presentation of Wyandotte at work, turn the page.

SODA ASH • CAUSTIC SODA • BICARBONATE OF SODA • CALCIUM CARBONATE • CALCIUM CHLORIDE • CHLORINE • MURIATIC ACID • HYDROGEN • DRY ICE  
GLYCOLS • SYNTHETIC DETERGENTS (anionic and nonionic) • CARBOSE® (Sodium CMC) • ETHYLENE OXIDE • ETHYLENE DICHLORIDE • PROPYLENE OXIDE • PROPYLENE  
DICHLORIDE • POLYPROPYLENE GLYCOL • DICHLORODIMETHYLHYDANTOIN • CHLORINATED SOLVENTS • OTHER ORGANIC AND INORGANIC CHEMICALS

# Designing a continuous hypochlorite unit



... an example of Wyandotte technical service at work



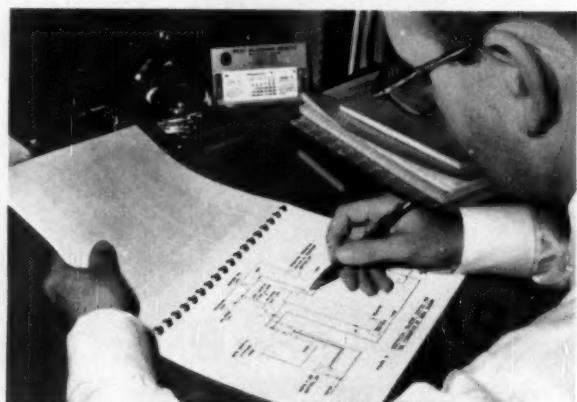
1 When he decided to build a new bleach plant, a Wyandotte chlorine customer took a wise first step: He called in a Wyandotte technical-service representative to weigh the economies of using the batch method versus a continuous unit, and recommend a course of action.



3 Wyandotte's pilot-plant unit for continuous production of hypochlorite helped solve problems ranging from design to optimum product properties. For, using oxidation-reduction potential, it can produce solutions of from 40 to 160 grams per liter available chlorine.



2 A continuous system was chosen because of better control, more uniform product, space savings, lower labor costs. Step Two: The plant was engineered by Wyandotte technical service to determine capacity, materials of construction, and properties of finished bleach.



4 A final report was prepared covering all phases of the installation. (Safety, of utmost importance, had not been overlooked.) This report—backed by firsthand experience and know-how—was then discussed with the customer by Wyandotte's technical-service man.

Wyandotte chlorine is sold with a guarantee of satisfaction. And it's backed by the highest caliber technical assistance . . . encompassing such helpful services as recommending handling and unloading systems, safety instruction, designing new processing equipment. Technical service is available to all Wyandotte customers. If you have a problem that falls within our technological or manufacturing background, check with us . . . our approach is designed to provide answers. *Wyandotte Chemicals Corporation, Michigan Alkali Division, Wyandotte, Michigan. Offices in principal cities.*

**Wyandotte CHEMICALS**

*Pacing progress with creative chemistry*

DEVELOPMENTS...

DECEMBER 1, 1958

# Chementator

C. H. CHILTON

**Lower-cost calcium carbide is claim of Stearns-Roger, Denver engineering firm, via "new processing methods" which entail less capital investment, labor and power than conventional facilities. Present work is aimed at utilization of Western lignites.**

**New aluminum alloy, designated X-8001, is used extensively in core of Argonne Low Power Reactor, being dedicated this month at Arco, Idaho. Containing 1% nickel, X-8001 alloy is much less costly than other materials (e.g., zirconium) used heretofore in power-producing reactors.**

**Fisher Scientific Co. will introduce this month its new zone-refining apparatus which automatically turns out hyperpure organic and inorganic chemicals.**

## New furnace for reforming methane

Scheduled for startup next month at Best Fertilizer's new 100-ton/day ammonia plant at Lathrop, Calif., is a novel furnace for steam reforming of methane. It has already proved its worth in two units now on stream in Germany.

Built by Selas Corp. of America, Dresher, Pa., the new furnace is a special modification of the Selas Gradiation heater, which is used widely in petroleum refineries. Like the Gradiation heater, the new furnace employs ceramic-cup radiant burners spaced at regular intervals in the opposing furnace walls. However, the catalyst-filled tubes in the Selas reforming furnace are disposed vertically, like conventional reforming furnaces, rather than horizontally. The Best unit is about 6 ft. wide and 30 ft. tall.

Design of the Selas furnace makes it possible to obtain optimum pattern of heat release throughout the furnace, without hot spots, by adjusting the settings of individual burners. Zone-control heating, says Selas, means higher capacity and longer tube life. Such control is difficult to achieve with conventional bottom-fired, vertical reforming furnaces.

Best Fertilizer actually got quotes from three builders of conventional reforming furnaces. Not only did the Selas furnace appear to provide operating advantages, it was also lowest in first cost.

## Prestretched Mylar for LP tape

Chemical technology has found a way to impart higher strength to extra-thin, long-play, magnetic sound-recording tape. The secret: Oriented prestretching of its Mylar polyester film base.

Manufacture of all Du Pont Mylar film includes some stretching for enhanced strength. But for the new type, called Mylar 50T, Du Pont has devised a way to stretch-orient a maximum number of molecules in one

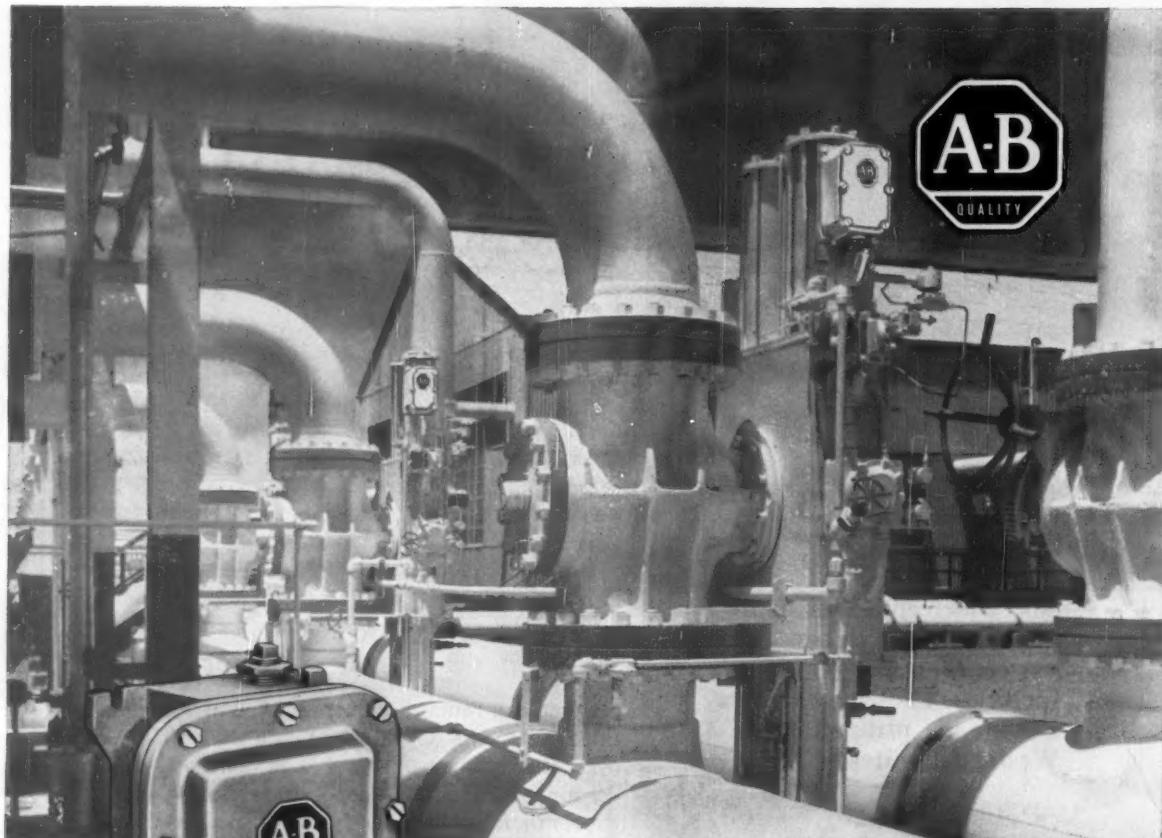
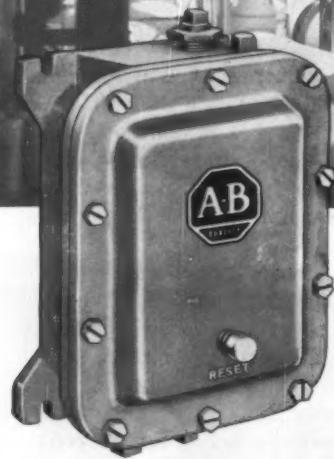


Photo Courtesy of El Paso Natural Gas Co.



Bulletin 709 Size 1 Solenoid Starter in NEMA Type 7 enclosure for hazardous gas locations.



Allen-Bradley Bulletin 709 across-the-line solenoid starters are made in nine sizes with maximum ratings up to 50 hp, 220 volts; 900 hp, 440-550 volts.

Allen-Bradley Co.  
1337 S. First Street, Milwaukee 4, Wisconsin  
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

## Complete "Safety" —At Lowest "Over-All" Cost!

It takes time—which is money—to inspect control in bolted NEMA Type 7 or NEMA Type 9 enclosures. Therefore, though the initial cost may be the same, it will reduce "maintenance" costs to select the control which does not require "regular" inspection. Such control is made by Allen-Bradley.

The simple contact mechanism for which A-B starters are famous has only ONE moving part. This is your assurance of millions of trouble free operations. There are no bearings to corrode and stick . . . no flexible jumpers to break. And the double break, silver alloy contacts never need servicing — they remain in perfect operating condition until completely worn away. In addition, all A-B starters have permanently accurate thermal overload relays that protect motors against burnouts — whatever the atmospheric conditions.

Specify Allen-Bradley *quality* motor control for *all* your installations . . . you'll save on maintenance and enjoy maximum safety.

**ALLEN-BRADLEY**  
MOTOR CONTROL  
QUALITY

direction. This concentrates the strength in the tape's lengthwise direction, enables it to absorb more punishment during use.

Break strength of the new Mylar 50T tape, 0.5 mil thick, is 120 oz. per  $\frac{1}{4}$ -in. width, compared with 56 oz. for Mylar 50A, a type of film not stretched via the new technique.

Within the past six months, four major tape manufacturers—Minnesota Mining, Audio Devices, Reeves Soundcraft and Or-radio—have started using Mylar 50T in answer to consumer demands for more durable double-play tape. Previously, the extreme thinness required to get 2,400 ft. on a 7-in.-dia. reel (instead of the usual 1,200 ft.) led to trouble with frequent breakage during the normal starting and stopping of home recording and playing equipment.

The new 50T-based tapes, though priced at retail at almost double the 50A-based tapes, are expected to capture about 20% of the amateur market, which in 1957 totaled about \$3 million in sales.

The industry does not expect it to make such a big dent in the professional market. Professional equipment accommodates larger reels than the 7-in.-dia. limit for home equipment. Therefore, extra-thin tape has no special selling point to offset the relatively low price of 1½-mil-thick cellulose acetate-base tape in general professional use.

### Polypropylene fiber is on the way

On both sides of the Atlantic, polypropylene is making news. In Europe:

- Polypropylene fiber is now definitely slated for commercial production by Montecatini. A 10-million-lb./yr. plant at Terni, Italy, will turn out both staple and continuous thread. Plant will be designed for rapid expansion to twice its initial capacity.

- Shell Chemical in Britain has started marketing limited quantities of polypropylene injection-molding resins under the trade name Carlonia.

Montecatini had previously announced its intention of boosting output of Moplen polypropylene plastic from its Ferrara plant to 20,000 tons/yr., nearly three times original capacity. And projected potential production is now put at 30,000 tons.

Chances are good that a U. S. polypropylene fiber won't be long on the way. Hercules tells *CE* that it is producing developmental quantities of a C<sub>3</sub> polymer especially

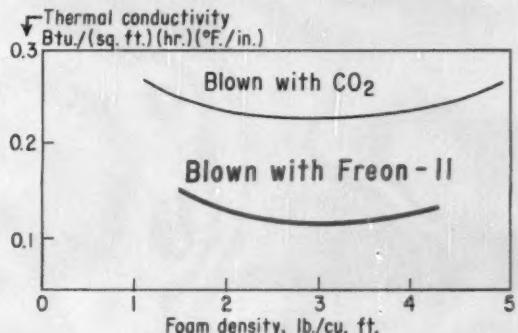
tailored for fiber manufacture. A number of potential spinners are working with this material, and progress has been significant. Hercules disclaims any intention of getting into the fiber business, will be happy to expand its 20-million-lb./yr. plant at Parlin, N. J., in order to supply resins to fiber producers.

Other related developments in this country:

- Eastman Kodak has announced its intention of building a commercial-scale polypropylene plant. Eastman, of course, is already well entrenched in both plastics and fiber fields.

- Enjay Co., a Jersey Standard subsidiary, has chosen the trade name Escon for the polypropylene it will market from Humble Oil's projected 40-million-lb./yr. plant at Baytown, Tex. Humble, another Jersey affiliate, will channel about half its output through Spencer Chemical's marketing organization.

### New foam makes better insulation

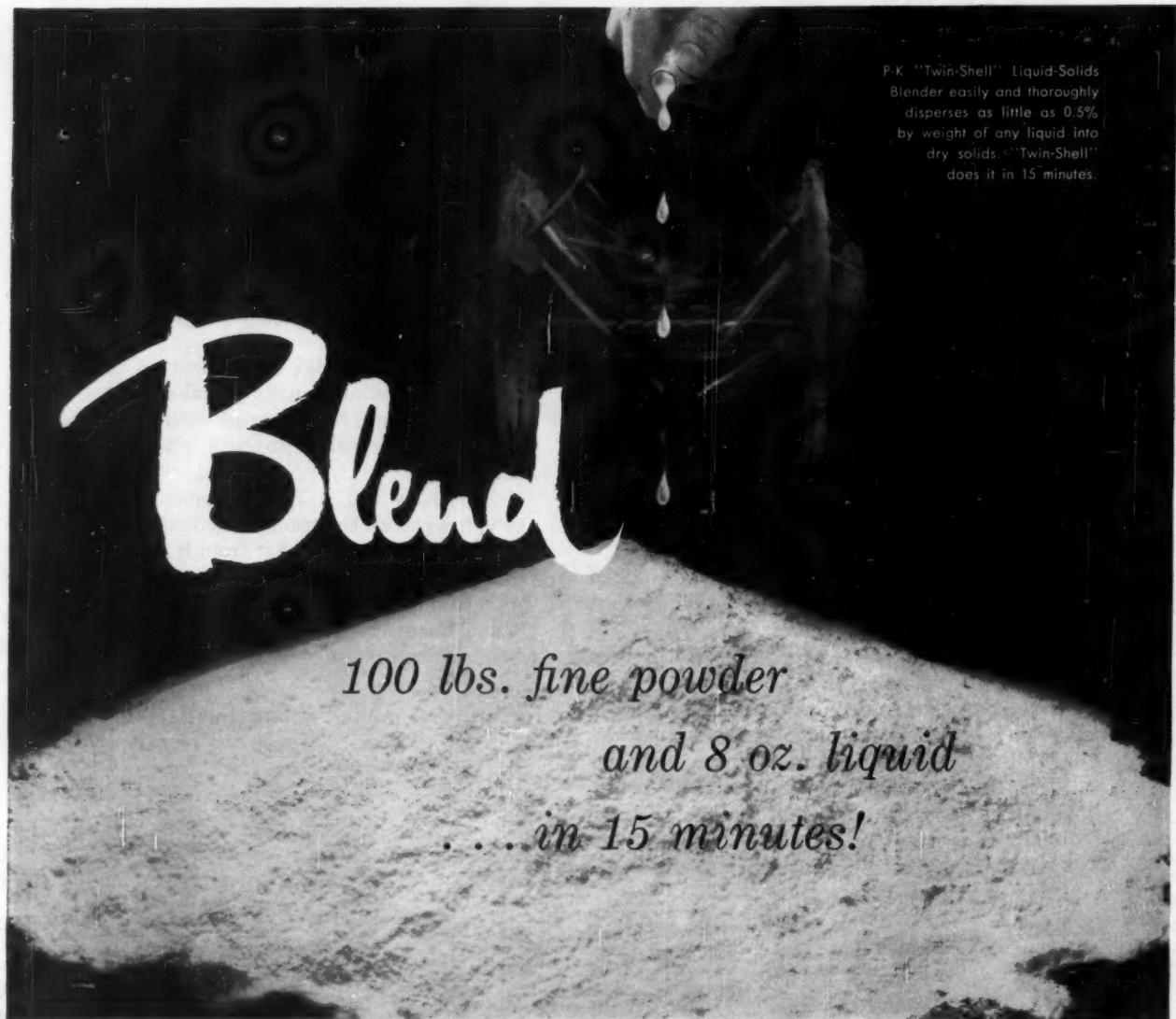


All major manufacturers of home refrigerators are reported in production or seriously considering production of models insulated with a new kind of rigid urethane foam.

In the new material, the foaming agent is a fluorocarbon gas instead of the usual carbon dioxide. Result: A marked decrease in thermal conductivity, permitting refrigerator makers to cut insulation thickness in half. This means less bulky outer dimensions or, conversely, more room on the inside.

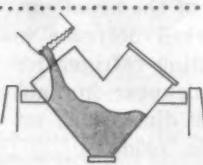
Urethane resins are made by reacting an isocyanate with a polyester or polyether. To get a foamed urethane, water is normally added, which reacts with excess isocyanate to liberate CO<sub>2</sub>.

(Continued on page 54)

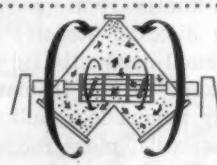


P-K "Twin-Shell" Liquid-Solids  
Blender easily and thoroughly  
disperses as little as 0.5%  
by weight of any liquid into  
dry solids. "Twin-Shell"  
does it in 15 minutes.

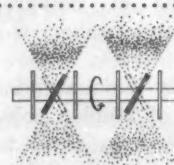
With the P-K "Twin-Shell" Blender the process industries can eliminate such post-blending operations as pulverizing and screening, with their time-consuming materials handling. Blending time itself is cut from hours to minutes. And some hitherto impossible blends are achieved easily with the P-K "Twin-Shell." Here's how "Twin-Shell's" unique design speeds processing:



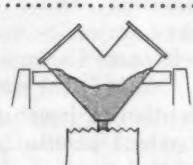
CHARGE DRY SOLIDS through top of either shell. Optimum charge level for most materials is about 65% of total shell volume.



TUMBLE AND AERATE. As shell revolves, rapidly spinning wire cage intensifier breaks up agglomerates, literally creates dust storm in material.



ADD LIQUID. Centrifugal force sprays atomized liquid from periphery of control discs on Liquid-Feed Bar into finely dispersed solids.



DISCHARGE PRODUCT easily through apex of shells. Accessibility of interior and easy removal of Liquid-Feed Bar speed cleaning.

See this new concept in blending! Accept this invitation... ➡ ➡

## Get new ideas for your blending process at P-K's Pre-Test Lab

Phone Stroudsburg 820 and arrange  
to make comparison tests — using  
your own formulations — at  
P-K's Pre-Test Lab.

P-K makes practically all kinds of blenders — conventional types as well as the radically different "Twin-Shell." Thus, P-K can give you impartial help in selecting the correct blending process for your needs.

But, blending is full of variables; don't decide on *any* blending equipment or process until you pre-test it with your own formulations. The Pre-Test Lab offers you an opportunity to do this with the aid of skilled blending technicians and proper equipment . . . and without obligation, of course.

You simply bring or send your materials to the Lab. Here the correct blending procedure and equipment for *your* job are determined by extensive tests. You receive a comprehensive report that can become the basis for an informed selection.

# You're invited

to pre-test your own formulations at the Pre-Test Lab. Write — or better yet, phone — Russell Dotter at P-K to set a date. (The number: Stroudsburg 820.) He will tell you how much of your materials to bring and will give you other details.

If you can't spare the time, send your materials anyway. But try to see the tests for yourself. If your process includes precision blending, your visit will be worth your while. The Patterson-Kelley Co., Inc., 1411 Hanson St., East Stroudsburg, Pa. (in the heart of Pennsylvania's scenic Pocono Mountains).

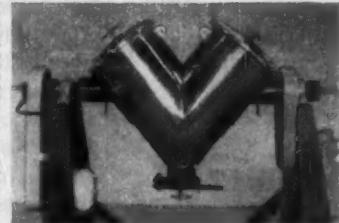
P-K Process Executive welcomes visitor to Pre-Test Lab at East Stroudsburg, Pa. Lab is equipped and staffed to make, or help you make, conclusive tests of blenders with your own materials.



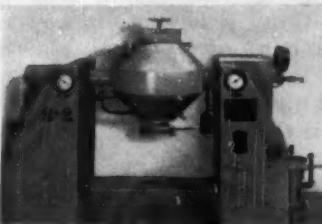
### TEST YOUR MIX WITH EQUIPMENT LIKE THIS



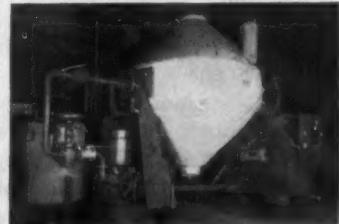
"Twin-Shell" Liquid-Solids laboratory models are made in transparent Lucite or stainless steel, in 8 and 16 quart sizes.



Production models of the "Twin-Shell" blender range up to 50 cu. ft. capacity. (Intensifier and Liquid-Feed Bar optional.)



Vacuum Tumble Dryers by Patterson-Kelley are available in sizes down to the standard 1 cu. ft. capacity lab model.



Production models of the Vacuum Tumble Dryers have capacities up to 150 cu. ft. Come factory aligned, piped, instrumented.

**Patterson**  **Kelley**  
Chemical and Process Division

The new foaming technique leaves out the water. Instead, the ingredients are dissolved in a liquid fluorocarbon (e.g., a Du Pont Freon or an Allied Chemical Genetron) which is initially a few degrees below its boiling point. As temperature rises, the fluorocarbon gasifies and foams the mixture.

Higher molecular weight of the gas trapped in the bubbles apparently accounts for lower conductivity of the foam. Other advantages:

- Reaction mass dissolved in liquid fluorocarbon is less viscous, flows readily into corners of the molds.
- Foaming action is slower than with water-CO<sub>2</sub>. This yields more uniform foam structure.
- Foam is less permeable to moisture.
- Amount of expensive isocyanate is reduced.

Nopco Chemical is exploring the possibility of making lightweight flexible urethane foams with the new technique. Here the objective is a one-third savings in isocyanate rather than improved insulating efficiency.

### New polyolefins show great promise

While polyethylene and polypropylene are enjoying the polyolefin spotlight at the moment, younger understudies are quietly being groomed in various laboratories for their commercial debuts. We refer to ethylene-propylene copolymers and to polybutylene.

• Hercules reports that its chemists have achieved "interesting results" with copolymers and with polymers of olefins above C<sub>3</sub>.

• Spencer explains a reference to "radically new polyolefins" in its recent annual report as meaning polybutylene and olefin copolymers. However, polymers of olefins beyond C<sub>4</sub> don't hold much promise, according to Spencer.

• Montecatini apparently has fairly definite plans to produce ethylene-propylene copolymers. The company states that part of the propylene from two new cracking units, in combination with ethylene, has been earmarked as source material to make other "unique and revolutionary products." And samples of olefin copolymers were displayed at last month's Plastics Show in Chicago.

Montecatini's Natta has described the C<sub>2</sub>-C<sub>3</sub> copolymers as "more interesting" elastomers than polyisoprene or polybutadiene,

current favorites in the development of synthetic polymers with properties similar to natural rubber (*Chementator*, Aug. 11, p. 71). Natta has also referred publicly to crystalline and amorphous forms of polybutylene whose degree of crystallinity could be controlled by proper catalysts.

### Coming: Purer metals at lower cost

Iodide process for producing ultra-high-purity metals takes on added stature with disclosure that Battelle Memorial Institute, Columbus, Ohio, has achieved major advances in process technology.

First beneficiary of this work will be Chromalloy Corp., White Plains, N. Y., who will license the process from Chilean Nitrate Sales Corp., sponsor of the development program at Battelle. Chromalloy will produce chromium containing less than 10 ppm. oxygen and 5 ppm. nitrogen.

In the classical iodide process, an impure metal reacts with iodine vapor to form the volatile metal iodide. The iodide decomposes on a hot filament to deposit pure metal, releasing the iodine and making it available for carrying out its function over and over again until the batch is done.

This process was rescued from obscurity about ten years ago as an expedient way to refine zirconium sponge, contaminated with oxygen and nitrogen, into high-purity zirconium for nuclear reactors. However, it has remained a relatively high-cost operation (processing cost was about \$25/lb., says Battelle).

Pending issuance of patents, Battelle is not at liberty to reveal engineering details of its improved iodide process. This much can be revealed: Process does not employ resistance-wire filaments; equipment is simple; large batches can run unattended for over a week; iodine loss, a potentially high-cost item, is negligible.

Chromalloy expects to put development quantities of iodide chromium on the market at prices considerably under today's \$85-125/lb. The company won't forecast an ultimate commercial price, but Battelle predicted several years ago that the ideal iodide process should be able to operate at a refining cost of \$2-5/lb. If this goal can be achieved, iodide chromium should find extensive use in alloys for high-temperature services such as gas turbines and nuclear reactors.

# Metallic Nitrates



Now available from two



**BAKER & ADAMSON® plants**

Cadmium, nickelous, cupric, lead, manganous, aluminum and other metallic nitrates are now available from two B&A plants—at Buffalo, New York, and Marcus Hook, Pennsylvania. Solutions are shipped in tank cars or tank trucks . . . crystals in polyethylene-lined drums.

#### Dependable, basic source

As the only producer of metallic nitrates with its own nitric acid production facilities, B&A can assure you of continuous, depend-

able supply. We have long been a prime source for high purity metallic nitrates . . . purified or technical grade, for general manufacturing use . . . reagent grade for more exacting requirements.

#### A complete line

B&A offers a complete line of metallic nitrates, including those custom-made to your requirements for special applications. If you contemplate producing your own metallic nitrates, you will probably find it advantageous to

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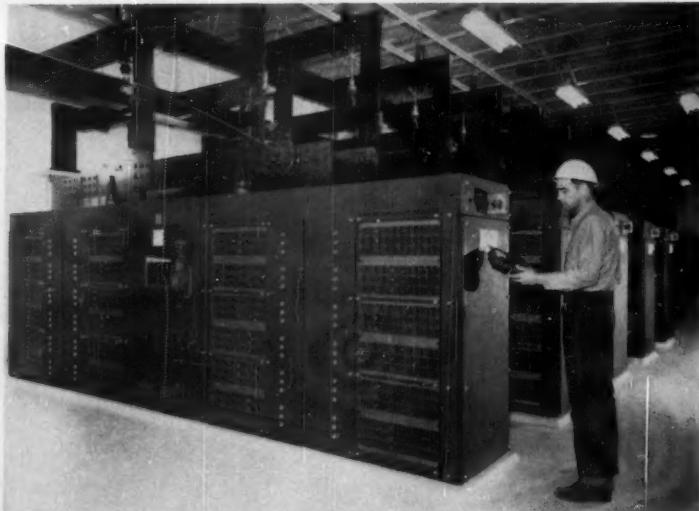
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DEVELOPMENTS . . .

## PROCESSES & TECHNOLOGY

C. S. CRONAN



TEN THOUSAND single germanium diodes (left) assembled in rectifiers (above) convert a.c. power to high-amperage d.c. for caustic-chlorine cells.

## Chemical Plant Uses Home-Made Rectifiers

**Leader among chemical plants using semi-conductor rectifiers, Columbia-Southern designed and built its own units from purchased components.**

At Natrium, W. Va., Columbia-Southern Chemical Corp. now uses germanium rectifiers developed by its own engineers to convert a.c. power to d.c. for production of caustic soda and chlorine in mercury cells.

On the line since early 1958, these rectifiers probably were the first large commercial units of this type to operate successfully in the United States. Even on startup, C-S had only minor trouble. And ever since then, these rectifiers have run with less than the normal number of difficulties.

► **Why Do-It-Yourself?** — Why did Columbia-Southern, a chemical company, choose to design a new type of electrical equipment that had never been used for a job of this type before?

In reply to this query, Colum-

bia-Southern's Chief Electrical Engineer, J. L. Michaelis, says, "Our management believed that the static type semi-conductor rectifier offered technical advantages over other types of rectifier equipment, and that we could build them more economically."

Performance of the Natrium rectifiers bears out fully the feelings voiced by Michaelis. Development of this equipment saved substantially on capital investment needs when compared to prices quoted for manufacturer-designed and integrated semi-conductor conversion equipment. And, to date, actual and expected maintenance costs appear to be considerably less than for conventional rectifier equipment.

Electrical efficiency is about

96.5% at a constant 96% power factor. Over-all, efficiency of the semi-conductor rectifiers may be 0.5-1.0% lower than that of mechanical rectifiers. But power factor may be about 8% better, all factors considered.

► **Diode Carries Load** — All work in Columbia-Southern's rectifiers is done by germanium diodes, small metal disks that can provide nearly 6 kw. of electrical energy. If utilized properly, these diodes can be expected to last almost indefinitely converting a.c. power to d.c. with approximately 98.5% inherent efficiency.

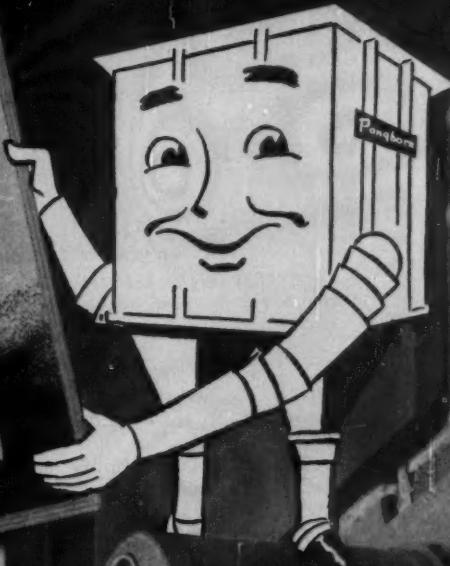
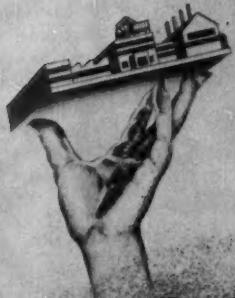
However, early in its development program, C-S realized that it would have to explore fully the close interrelationships of many engineering problems if it was to utilize these characteristics successfully.

► **New Concept, New Approach** — To develop its concept of a large rectifier substation using approximately 10,000 individual

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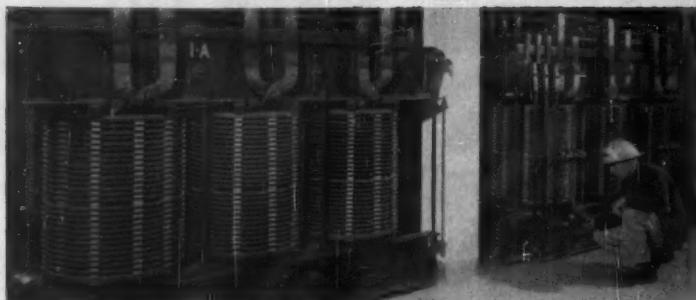
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STANDARD air-cooled transformers supply low-voltage a.c. power through simple, close-coupled connections to rectifiers on floor above.

diodes, C-S had to open new approaches to a practical design.

A diode has virtually no thermal storage or overload capacity, voltage surges will destroy it instantly. Therefore, each of the 10,000 diodes sharing the load needs adequate cooling to remove heat generated by its internal losses. And each must be readily identifiable and physically accessible in case of failure.

Columbia-Southern worked all its design concepts into a prototype rectifier which Electrical Engineer E. T. Myslinsky installed and operated at Natrium to establish limitations for this type of equipment under actual plant conditions. Results obtained under normal, abnormal and unfavorable conditions provided the basis for design of the final commercial rectifier installation.

► **Includes Refrigeration** — To control diode temperature, C-S chose air cooling rather than liquid cooling with its associated complex, high-maintenance piping system involving 10,000 to 20,000 individual connections.

Installation delivers large volume of air so that each diode receives its proper share at the correct velocity and temperature. An auxiliary refrigeration system has proven effective and economical for controlling air temperature.

► **Standard Transformers** — Natrium's electrical design provides flexibility for operation above 250 v. and 100,000 amp. d.c. Power comes directly from a 66,000-v. utility supply line.

A substantial advantage for the germanium rectifier is that it can operate in conjunction with standard, distribution-type power transformers. Contrast this with mercury-arc rectifiers which occasionally arc back and must, therefore, use the more expensive double Wye-type transformers.

Michaelis and Myslinsky believe that standard distribution transformers on this service should have life expectancy equivalent to that for any other industrial power transformers used in the U.S. chemical industry.

In the finished installation at Natrium, C-S used more than 20 conventional air-cooled, semi-standard power distribution transformers. To simplify the mechanical problem of installing so many units and connecting them to their respective rectifier loads, the engineers located them indoors with provision for circulating cooling air. That way, only short simple electrical connections were needed between transformers and rectifiers.

► **Special Features** — In themselves, germanium rectifiers have no voltage control such as grid control utilized by mercury-arc rectifiers. Thus, equipment is included to change taps under load in order to vary voltage for controlling cell operation.

Good operation of electrochemical cells requires continuous knowledge and a record of current flow. To obtain this information, Columbia-Southern adopted a simple but entirely new way to meter approximately

100,000 amp. d.c. Accurate within 0.5%, this new metering method can be verified by standard instruments available in any industrial plant.

► **Low-Level Maintenance** — A big advantage offered by a germanium rectifier is its ability to "store" faulted or burned-out diodes. With nearly 10,000 diodes on the line, a certain number will fault over a period of time. Yet, so small is the reduction in total load-carrying ability that they can be left in the circuit up to three months before replacement. Then, when convenient, a maintenance man can replace all faulted diodes at once.

All that maintenance man does is to identify the defective units and replace them. Thus, the level of electrical knowledge required for this job hits a new low for any known type of industrial power conversion equipment.

► **Many Contributed** — Equipment in the final operating station came from various manufacturers, both large and small. Yet most of it is standard design and familiar throughout the industry. Choice between various alternates rested finally on simplicity, adequate capacity and relative ease of maintenance.

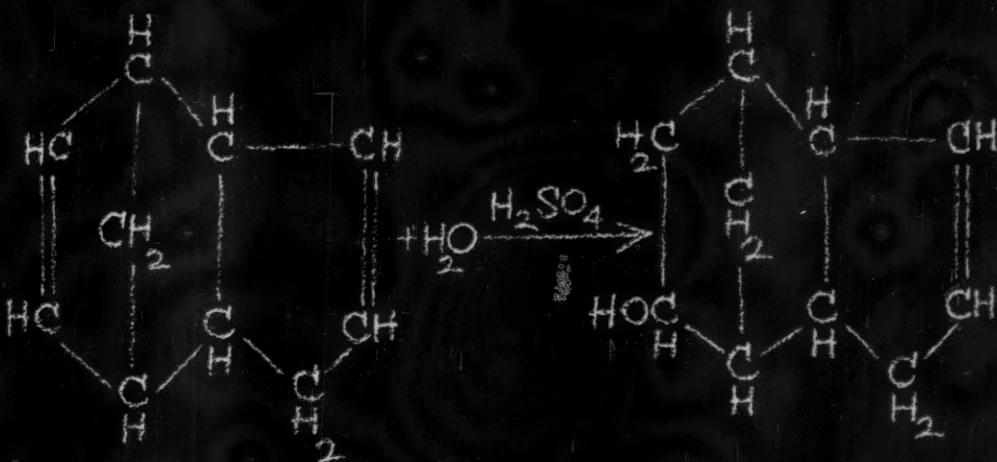
► **Silicon Next** — A silicon prototype rectifier is now operating satisfactorily on the production line at Columbia-Southern's, Barberton, Ohio plant. With present availability of quality silicon diodes, which were not available commercially during the Natrium development program, silicon may supersede germanium.

Silicon can operate at higher temperatures and voltage ratings. Therefore, it would not need refrigeration, would deliver a given operating voltage level with fewer units in series. End result would be even greater savings.

While C-S is bullish on increased use of semi-conductor rectifiers by the chemical process industries for operating levels as high as 750 v., its engineers caution that use of semiconductor diodes must be limited stringently within their capabilities.

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### Insulation Makes Motor Indifferent to Flames

Although most engineers don't need an electric motor meeting such rigorous specifications, Westinghouse says that it has an insulation for motor windings that permits motor to run continuously in an oven at 1,000 F. or even in open flames (above). This severe test was designed as a practical work-out for Westinghouse's new insulation system developed for severe-temperature electrical service like that encountered in missiles and jet aircraft.

Westinghouse's E. J. Croop, manager of insulation and chemical development, says that the new insulation "differs from any now in use." Rotor wires are insulated by covering with glass fibers and impregnating with a suspension of powdered mica in a phosphate solution. Wire insulated in this fashion is flexible and can be wound.

After winding, coils are impregnated with a slurry of a phosphate solution, silica, "and other chemically reactive materials." Silver wire instead of copper wire is used in the experimental motor since copper oxidizes and becomes useless as a conductor.

### Aussies Study New Route To Rutile From Ilmenite

Now under study in Australia is a two-stage route to produce substantially pure titanium dioxide in rutile form from ilmenite ore. The project, sponsored by four Australian companies, is re-

portedly making considerable progress.

Even design data for a practical reaction system have been obtained by chemical engineering section of the Division of Industrial Chemistry, Commonwealth Scientific and Industrial Research Organization in Melbourne.

First stage involves reaction of ilmenite with sulfur vapor at 700-850 C., followed by hydrothermal oxidation of sulfided product in an autoclave at 100-140 C. In second stage, iron compounds are removed, leaving fairly pure titanium dioxide and recovering elemental sulfur. Study of the ilmenite-sulfur system has been carried out in a small, batch-operated, fluidized-bed reactor.

### Oxide Reduction Process Ready to Go Commercial

Hydrometals, Inc., of New York, N. Y., is readying plans to commercialize a new electro-thermal process for rapid reduction of metallic oxides. Firm acquired licensing rights from Electro-Thermal Industries, Inc. which developed the process after seven and a half years of research.

Main advantage of the process, according to Hydrometals, is the single reduction step that can lead to economical production of metals that are now quite costly. Oxides of metals such as columbium, tantalum, boron, tungsten, vanadium, zirconium, titanium and beryllium can be reduced via the new technique.

Without specifying reducing environment, firm describes process like this: "Materials to be processed" are placed in a hydraulic press at high temperature and pressure. A low-voltage electrical charge triggers an electrothermal reduction reaction that raises temperature in vessel to around 5,000 F. and pressure as high as 1 million psi.

Reduced metals are then removed for further finishing. These intense reaction conditions also make it possible to alloy certain metals that can't be combined ordinarily by charging a mixture of oxides to the reduction chamber.

Hydrometals plans to produce several unspecified metals by this process and to license it throughout the world.

### Isomerizing Steps Up, Bites Deeper Into C<sub>5</sub>'s

Two recent commercial developments signalled renewed activity in isomerization: Shell Oil Co.'s process modification for boosting yields and reducing equipment requirements in its liquid-phase, butane-isomerization unit at Wilmington, Calif.; and Phillips Petroleum Co.'s first report on operation of its pentane-isomerization unit at Borger, Tex.—the first such unit to go on stream.

Key to Shell's improved isobutane route is the reactor (details still under wraps) which achieves a close approach to slug flow and virtually eliminates back-mixing. Conversion per pass of butane to isobutane has been increased from 51% in former agitated, autoclave reactor to about 60%.

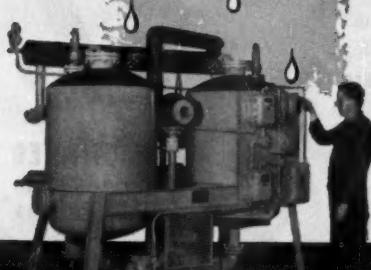
Because of the higher isobutane content of reactor effluent, Shell points out, capital investment in a new plant using improved reaction system would be about 15% less than in an old plant of equivalent capacity.

► **Penex Proves Out**—Phillips, using Universal Oil Products' Penex process to isomerize pentane, reports having produced 12,544 bbl./day of isopentane product of 96% by volume isopentane. Phillips' unit is designed to handle a maximum of 34,400 bbl./day of 85% normal pentane reactor feed and produce 16,000 bbl./day of 95% isopentane.

Isopentane product is 95.6 Research octane, clear, and 104.1 Research octane number, with 3 ml. TEL.

Commercial Penex unit has confirmed UOP's research finding that there is no neopentane in the reactor product. This, according to UOP, is consistent with established carbonium ion mechanism for the isomerization reaction. It's commercially important because neopentane's leaded octane number is about seven units below that of isopentane.

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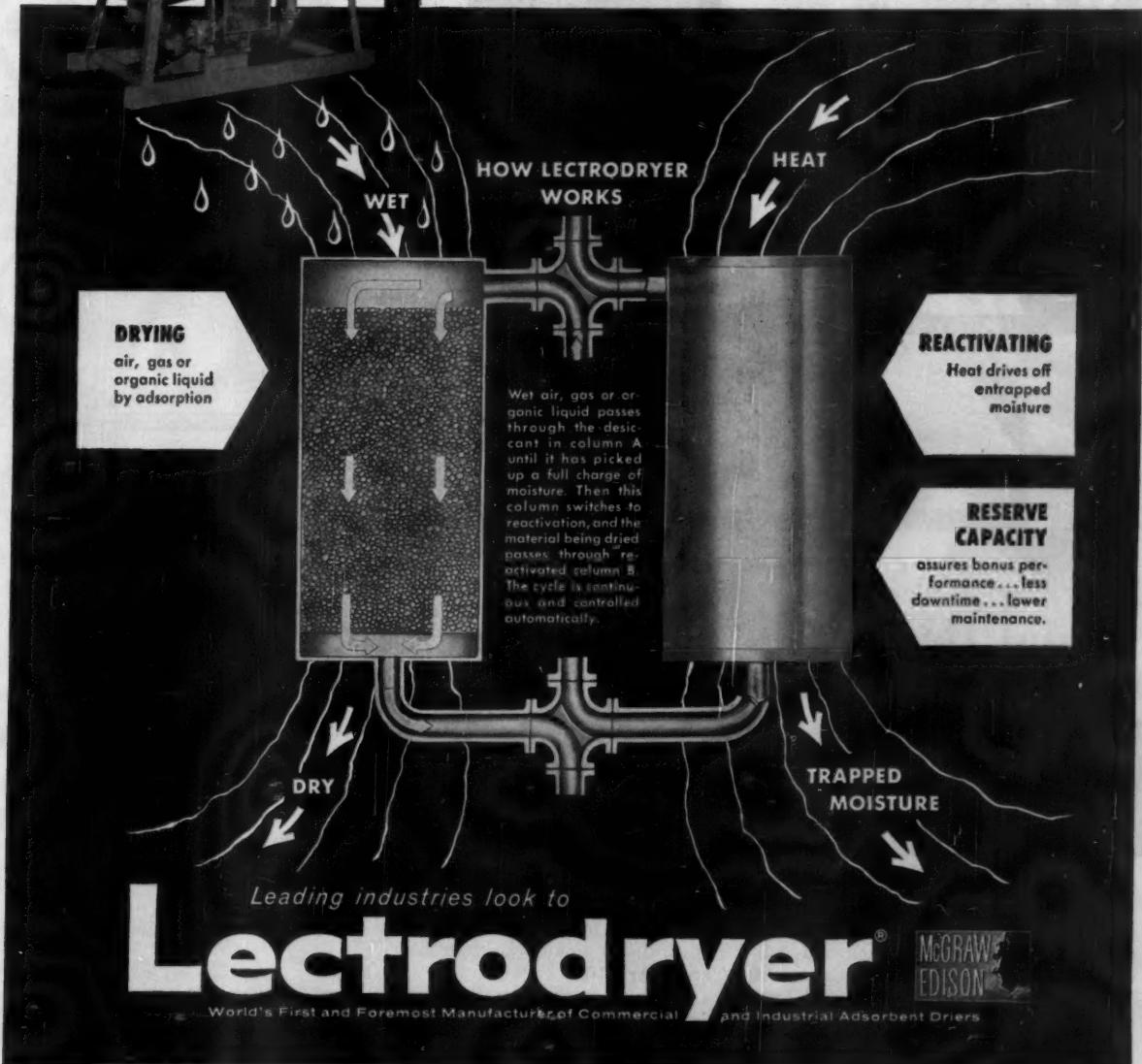
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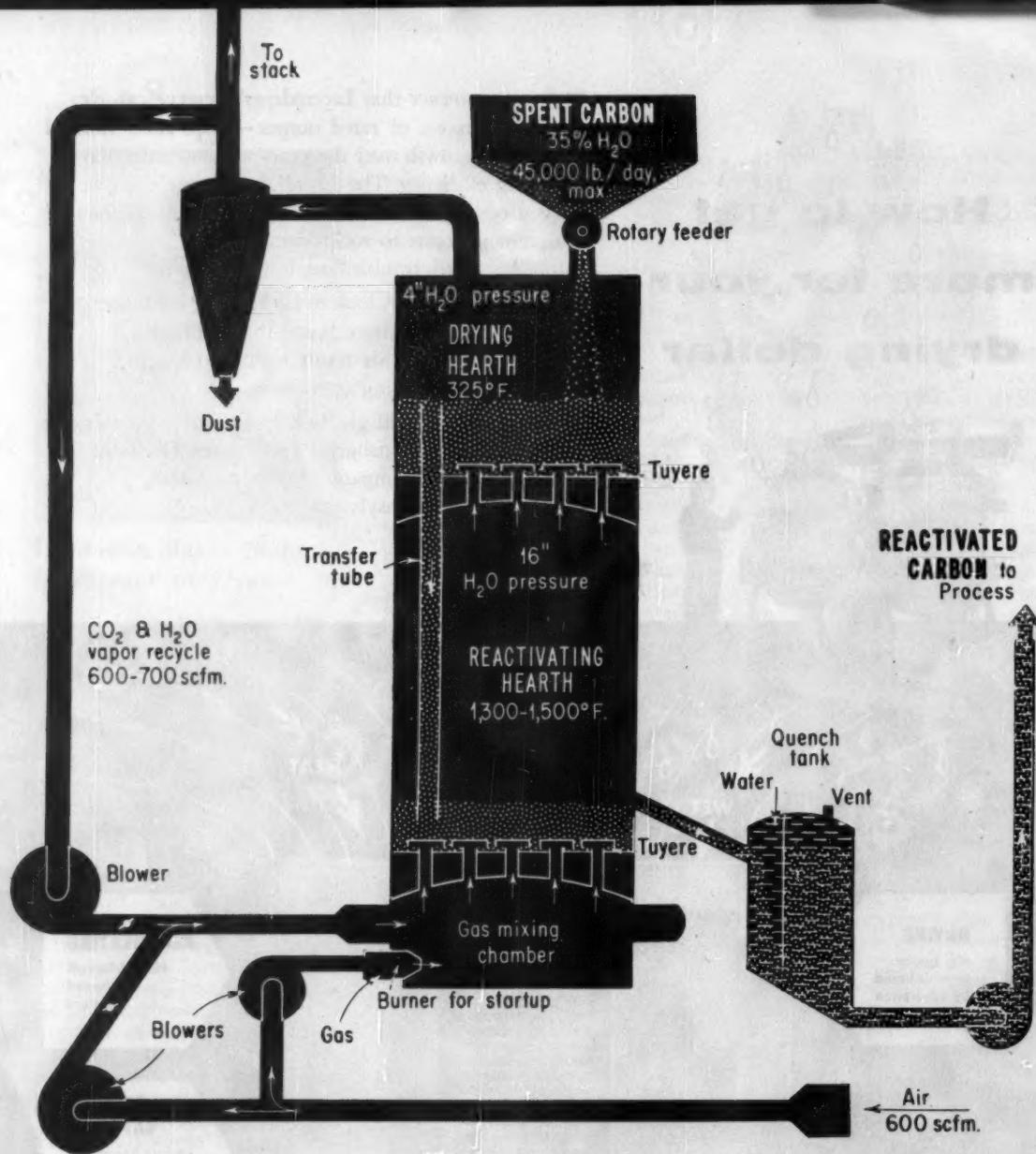
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downtime...lower  
maintenance.

#### TRAPPED MOISTURE





## Fluid Bed Under Trial Regenerating Carbon

Dextrose refinery reports that fluid-bed kiln successfully regenerates granular decolorizing carbon, now strives for optimum conditions.

A third process-equipment candidate for regenerating granular activated carbon has moved into the spotlight. At Corn Products Refining's North Kansas City dextrose refinery, a fluid-bed kiln (Dorr-Oliver

FluoSolids system) is just rounding out four months of continuous operation handling spent granular carbon.

This is the first fluidized system to revify any decolorizing agent.

Fluidized regeneration's solid competitors for this kind of job—to exploit the demonstrated adsorptive powers of granular activated carbon—are the Herreshoff furnace (*Chem. Eng.*, Sept. 1955, p. 122) and the rotary kiln (*Chem. Eng.*, March 10, 1958, p. 80).\*

Carbon revification is an un-

\*A rotary kiln shouldn't, perhaps, be directly compared with Herreshoff and fluid-bed kilns. The rotary is probably the best bet for throughputs under 10 tons/day, whereas the latter two systems come into their own at higher production levels.

# IN SRE... Zallea expansion joints absorb thermal expansion of reactor core tank and outer tank

The very nature of the Sodium Reactor Experiment, conducted by Atomics International for the AEC, and the method of handling the liquid sodium reactor coolant demand reliability in expansion joints. Because of the operation there can be no compromise in design or quality.

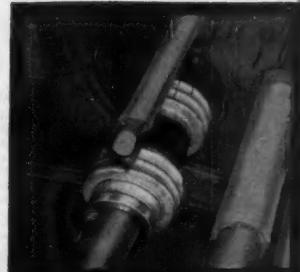
The high temperature SRE uses Zallea Expansion Joints where thermal expansion must be absorbed and where a gas seal must be maintained. An 11-ft. diameter Zallea Expansion Joint at the top of the outer tank absorbs the expansion that results from the temperature increase in these components as the reactor comes up to operating temperature, 960°F. In addition, the expansion joints form a seal for the helium gas and sodium vapor above the sodium pool at the top of the reactor as well as for the helium gas within the outer tank.

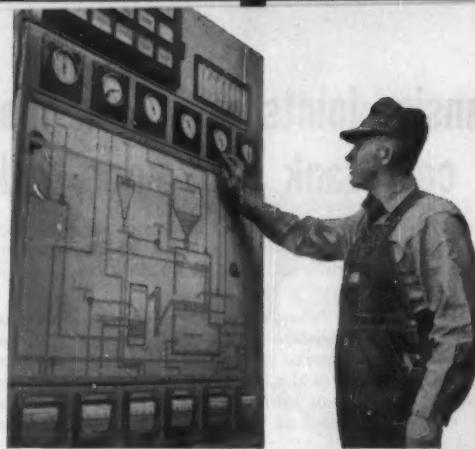
In the sodium coolant piping circuit gas seals are effected by means of Zallea Expansion Joints in the region where the pipes leave the reactor cavity and enter the pipe galleries.

Zallea has worked with almost every major engineering and manufacturing firm engaged in atomic, nuclear and missile work—and has provided the large majority of expansion joints for such projects. As a result, we have accumulated a store of expansion joint engineering data and manufacturing skills that cannot be equalled. Whenever expansion is involved in piping systems, reactors, tanks—whatever the application—let our engineers work with you. We already have the answer to many of the difficulties you will encounter. And we welcome the chance of tackling your problem.

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GLANCE at panel board tells operator how fluid-bed kiln is operating.

familiar role for high-temperature fluidized processing, which is more at home in, say, metallurgy and catalyst regeneration. The new role establishes a broader potential for fluidization inasmuch as carbon reactivation is a different cup of tea from ore roasting and catalyst burning.

► **Burn With Care**—In Corn Product's particular situation, for example, material is being oxidized from a combustible surface at temperatures on the order of 1,500 F. Close temperature control is a must, lest you burn, instead, the material you seek to revivify.

CP engineers don't feel they have all the answers, yet, on how to get maximum reactivation with minimum destruction of carbon. "The problem with the unit right now is finding optimum operating conditions," says Chief Engineer Bill Brinker.

Nor is CP ready to say a fluid-bed system is the ultimate answer to granular carbon reactivation. After all, they are getting good service from two Herreshoff kilns right now at the company's Pekin, Ill., refinery.

► **Solid Plusses**—But they are quick to point to some impressive performance features, nevertheless:

- Lower operating costs—No fuel needed except to start up. Combustion of adsorbed impurities in carbon is self sustaining in fluidized operation.

- Lower capital cost—Fluid-bed kiln is smaller and less costly than Herreshoff of equal capacity.

- Flexibility—Operating conditions may be varied with greater speed and ease than in Herreshoff.

- Close control—Intimate contact between gas and carbon particles permits maintenance of uniform temperatures through the bed.

- High heat transfer—Credit intimate gas-solid contacting for this, too.

Corn Products is reluctant to put a dollar figure on the capital cost of the fluid-bed unit in view of the significant developments and modifications since initial installation. But Asst. Chief Engineer H. C. Frost estimates capital cost of the unit at \$2.5/lb. of spent carbon throughput per day.

► **Too Hot to Handle**—When Corn Products switched three years ago from bone char to Pittsburgh Coke and Chemical's granular activated carbon, it also had to switch from regeneration in old vertical tube-type kilns. The new carbon had such an avid adsorbent capacity for impurities that it could not be reactivated satisfactorily at volatilization temperatures. Much adsorbed material had to be burned off, as well, which meant going to a temperature range of 1,300-1,500 F. This was too hot for the tube-type equipment.

CP's first answer to this problem was the Herreshoff furnace, two of which are operating at the Pekin plant (*Chem. Eng.*, Sept. 1955, as noted above). But the fluid-bed technique offered advantages worth investigating.

► **Quick and Sure**—Perhaps the greatest operating advantage has been flexibility. A fluid-bed unit can, for instance, be brought to operating temperatures (1,500 F.) in two hours; time required for a Herreshoff is 15 hr.

By the same token, once

you've attained optimum conditions, you can maintain them more surely in fluid-bed operation.

And since at this stage of the game CP hasn't finalized on optimum conditions, "it is a striking operating advantage to be able to vary conditions easily," comments Frost.

Corn Product's fluid-bed unit is a double-hearth, dual-bed, 40-ft.-high steel cylinder lined with fire brick. It is designed to carry out two separate operations consecutively: drying incoming spent carbon and then revivifying the same.

Drying takes place in the upper hearth, 3.5-ft. I.D., with a bed 18 in. deep. Regeneration takes place in the lower hearth, 4.5-ft. I.D., with a bed 12 in. deep.

► **Dry and Revivify**—Spent wet carbon from the decolorizing beds moves from a hopper via a rotary feeder into the upper hearth. Carbon contains 35% moisture and is contaminated with organic color bodies (mostly hydroxymethyl furfural) from dextrose treatment.

Dried carbon overflows from the upper hearth through a transfer tube to the revivification hearth below and then to a water-quench tank. From there the regenerated carbon is pumped in a water slurry back to the decolorizing beds.

Over-all carbon retention time in the kiln is 30 min.

At the same time, 600 scfm. of air, mixed with 600-700 scfm. recycle gas (chiefly CO<sub>2</sub> and water), passes up through tuyeres in the lower hearth, through the fluidized bed of regenerating granular-carbon, through tuyeres in the upper hearth, and finally to a dust collector.

Exit gas from the dust collector is ejected to the atmosphere or recycled to the gas-mixing chamber at the kiln's bottom to facilitate close temperature control.

Water is driven from the carbon in the upper hearth where temperatures run about 325 F., and pressure about 4 in. H<sub>2</sub>O. Impurities are volatilized and oxidized from the carbon in the lower hearth at roughly 1,300-1,500 F. and 16 in. H<sub>2</sub>O.

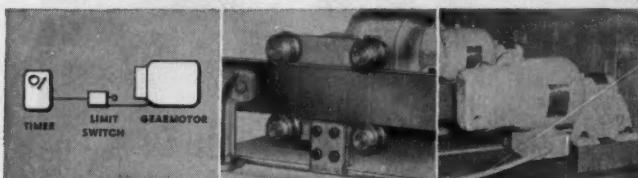
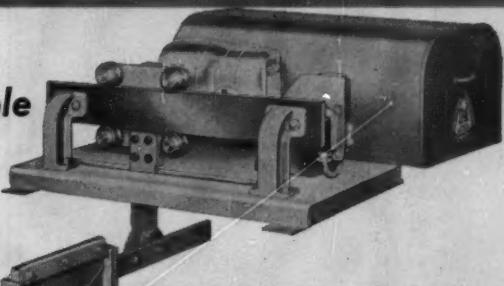
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# DENVER SAMPLERS

## Automatic Samplers

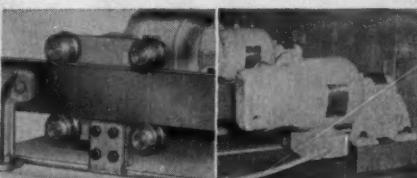
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### Gearmotor Drive

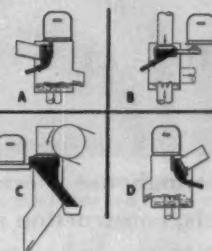
Totally enclosed, non-ventilated gearmotor operates in one direction only. Cutter travel limited by magnetic brake. Carriage and chain stop together, start together. Explosion proof motors are available.

### Easy-to-Set Timer

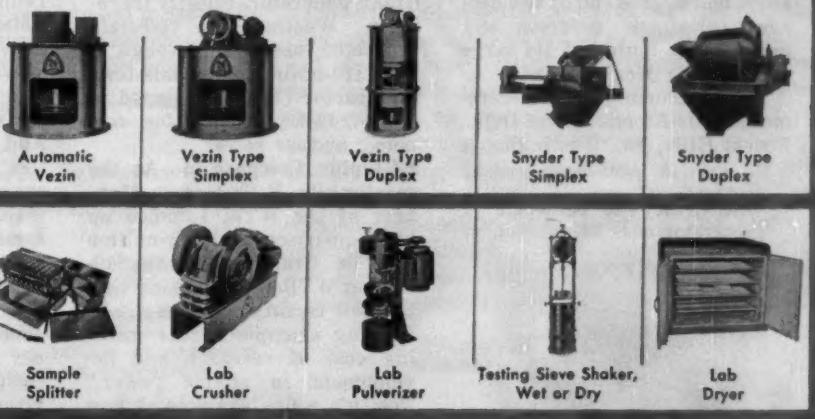
Simple, Telechron driven automatic reset timer. Easy-to-set for intervals from 2 to 35 minutes in 1 minute increments. No gear trains to change, no timing complications like those encountered with reversing motors.

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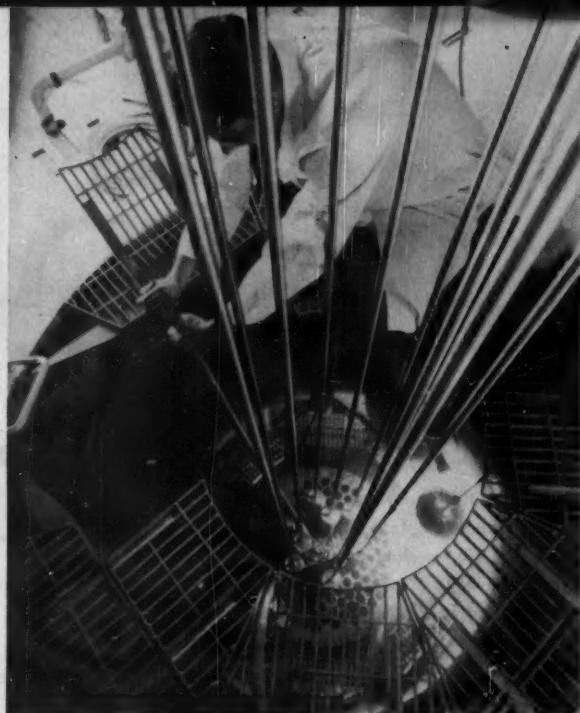
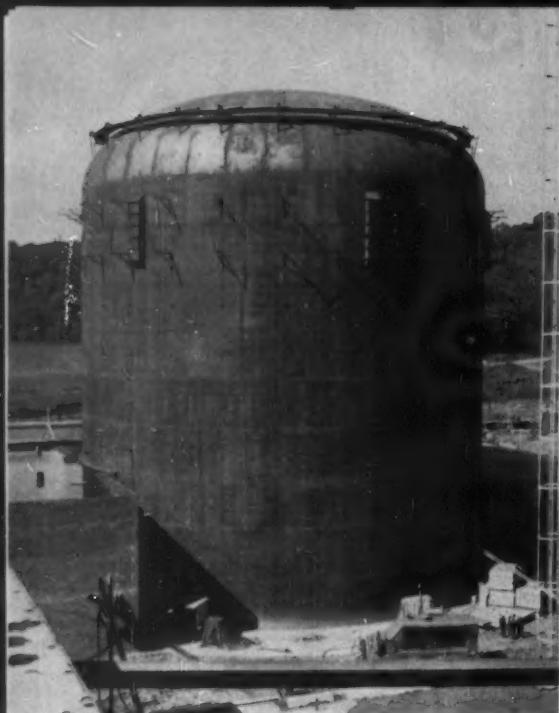
Complete Mill Equipment

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TELLTALE of an atomic reactor, this vapor container (left) will house new Westinghouse testing reactor (WTR) whose core is now undergoing evaluation (right).

## Nuclear Testing Moves Into Private Hands

**With six major nuclear projects on its active list, Westinghouse is erecting big testing reactor to prove out fuels, construction materials and coolants.**

Recently, within a few short hours, Westinghouse Electric Corp. marked the end of two decades in atomic progress and gave public notice of its large stake in the decade ahead.

In a decommissioning ceremony at its Atomic Power Dept., Forest Hills, Pa., Westinghouse

ended the 20-yr. career of the world's first industrial Van de Graaff generator. Shortly thereafter, Westinghouse officials conducted newsmen through a new \$10-million materials-testing reactor (WTR) designed to help industry's drive for economic nuclear power.

► **Graphic Comparison**—At the reactor site, E. T. Morris, Manager of the WTR, summed up his comparison of the \$1-million Van de Graaff with the \$10-million WTR by remarking that the new facility provides . . . "a striking example of the growing cost of research and development in atomic power." Too, it's a fine example of how private industry is committing a healthy slice of its own resources to develop nuclear power technology.

► **Ends Reliance on AEC**—Located on an 850-acre site at Waltz Mills, 30 miles southeast of Pittsburgh, the WTR joins

General Electric's GETR test reactor at San Jose, Calif. as the nation's first privately owned test reactors. Thus, industry will no longer be completely dependent upon the three test reactors operated by the AEC at Arco, Idaho and Oak Ridge, Tenn.

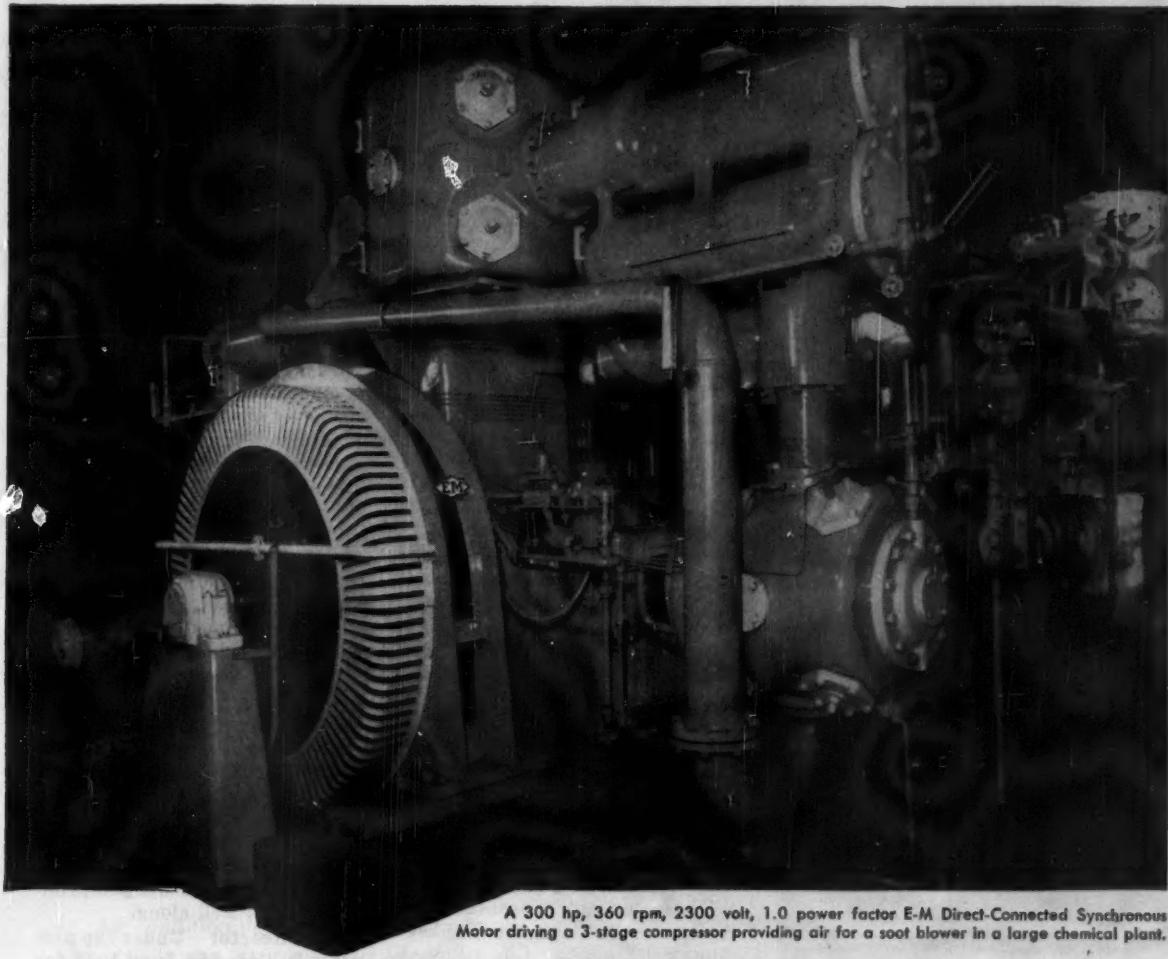
► **Many Environments**—With the WTR, Westinghouse will provide appropriate environments for testing power-reactor fuels, materials and coolants. And with the associated facilities, the company will be able to examine and evaluate tests.

Because of built-in flexibility, a materials-testing reactor can determine experimentally the behavior and performance limits of individual materials and combinations of materials under a wide variety of pressure, temperature and neutron environments.

For example, the WTR will be able to accommodate experiments under environments up to 2,000 psi., 625 F. and  $10^4$  neutrons/sq. cm./sec. Then, irradiated specimens can be transferred directly from the reactor to the hot laboratory for ex-

PIONEER Van de Graaff generator ends 20-yr. stint.





A 300 hp, 360 rpm, 2300 volt, 1.0 power factor E-M Direct-Connected Synchronous Motor driving a 3-stage compressor providing air for a soot blower in a large chemical plant.

## What every new compressor should have

● Nicest thing you can do for a new large compressor is to couple an engine-type synchronous motor to it. There's no better way to assure a most economical, reliable and trouble-free drive. Look at the advantages:

1. **HIGH EFFICIENCY** conversion of electric power to mechanical power by synchronous motors . . . resulting in minimum electric power cost operation of the compressor.
2. **POWER FACTOR CORRECTION** by unity or 0.8 leading power factor synchronous motors . . . supplying leading reactive kva to improve plant power factor and further reduce power costs, save money on your power bills.
3. **DIRECT-CONNECTED** synchronous motors save valuable floor space and require minimum maintenance.
4. **SIMPLE STARTING** at full voltage is suitable for most direct-connected synchronous motor compressor applications. Or you can use E-M-invented part-winding starting where starting limitations are severe. E-M starting arrangements are low in first cost and maintenance cost.

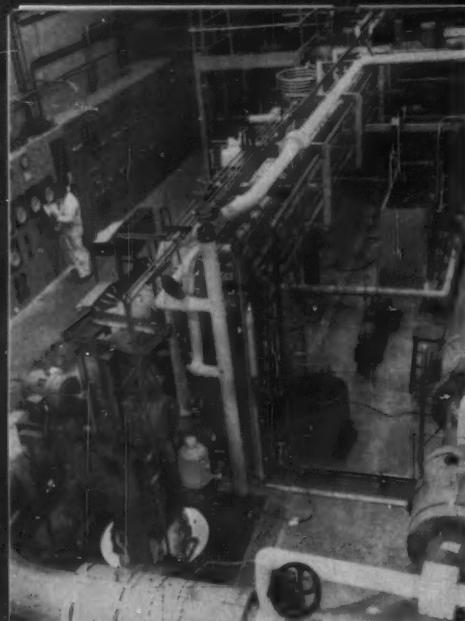
And there's nothing nicer for your compressor than an *E-M* Direct-Connected Synchronous Motor. *E-M*, pioneers in the development of synchronous motors and control, have over 40 years' experience in the design of synchronous motors incorporating desirable characteristics and features such as those above.

Let the *E-M* specialist engineer team design a smooth-running, modern drive unit to meet the requirements of your new compressor application. For complete information on *E-M* Synchronous Motors and their application in your plant, consult your nearest *E-M* sales engineer. And write for the issue of the *E-M* Synchronizer titled "The ABC of Synchronous Motors".

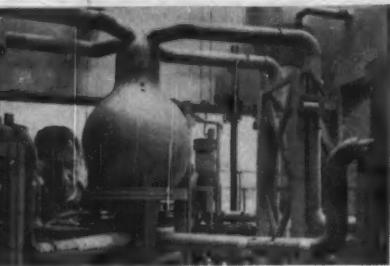
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MILLION dollar loop at Westinghouse atomic power department, Forest Hills, Pa. (above) simulates handling of fuel slurry for aqueous homogeneous nuclear plant development (below).



amination. Route of the hot irradiated specimens is along the bottom of an 18-ft. deep, water-filled canal that spans the 100-ft. distance between reactor and laboratory.

► **Some Other Features**—Offset from the canal will be a facility for measuring the reactivity worth of fuel elements and control rods both before and after irradiation. And on the opposite side of the canal a gamma irradiation station will use spent WTR fuel elements to provide a gamma level of  $10^8$  roentgens/hr. for volumes up to 5 ft. dia. and 3 ft. high.

Other than the main reactor, two critical experiment stations are operating now at the Waltz Mill site.

One of these, the Westinghouse reactor evaluation center (WREC), first operated on experiments with the core of the Yankee Electric Co. reactor, now is running experiments for a Belgian thermal reactor.

#### PROCESSES & TECHNOLOGY . . .

The other, critical experiments station (CES), is being used for experiments on the WTR core.

These two stations can perform critical experiments with almost any type of nuclear core. ► **Basic Reactor Facts**—Initially, the WTR will operate at a thermal power level of 20 megawatts (mw.) but operation may eventually reach 60 mw. Reactor core will contain 60 enriched-uranium fuel elements housed within 33-ft.-high by 94-in. I. D. pressure vessel.

Ordinary water flowing at 13,660 gpm. serves as coolant and moderator. Entering the pressure vessel at 115 F., the water picks up enough heat to rise to 125 F. before discharging. Passing to heat exchangers, this water gives up its heat to external water circuit tied to cooling towers.

**Much Work Ahead**—Beyond a doubt, when the WTR becomes operational in May 1959, it faces a busy time picking up its share of the six major development and construction programs now underway in the Westinghouse atomic power department.

These include pressurized-water reactors for the Yankee Atomic Electric Co., Rowe, Mass. and the Societe Cooperative Electro Nucleaire, Mol, Belgium; a pressure tube reactor for Carolinas-Virginia Nuclear Power Associates, Inc.; and a homogeneous reactor for Pennsylvania Power & Light Co., Allentown, Pa.

Foremost among the design programs for new reactors is

**MODEL organic-moderated fluid-bed reactor for Burlington, Vt.**



the use of thermoelectric materials in the fuel elements in order to convert fission heat directly into electricity. And another new design uses pelletized uranium oxide fuel which is cooled, moderated and controlled by circulating diesel oil (Chem. Eng., Nov. 17, 1958, p. 66; also note picture below).

► **Yankee Project**—Development work on this project was related to improved core design and efficiency aimed at lower power-generating costs. Experiments have confirmed choice of stainless-steel cladding for the slightly enriched, pelletized-uranium-oxide fuel elements. A significant feature of the operation will be nucleate boiling of water on the surfaces of fuel elements to speed up transfer of heat into the body of the liquid.

Final decisions on core design will come by end of year; plant will operate by end of 1960.

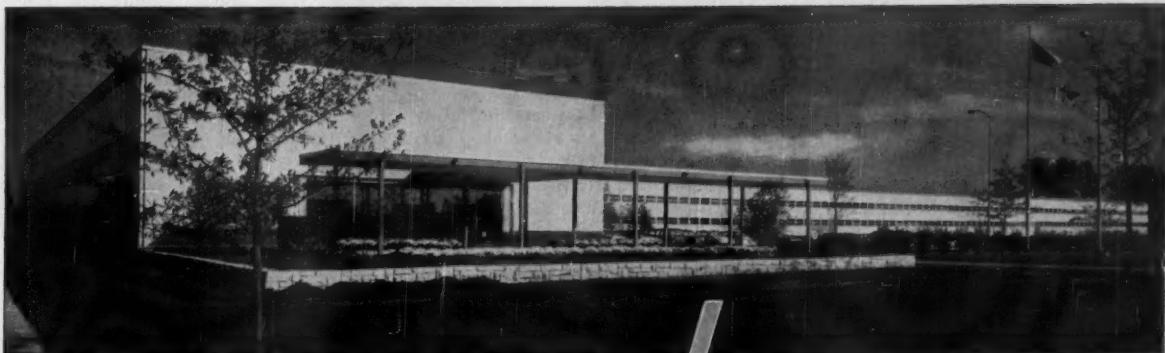
► **Belgian Reactor**—Included in the 10.5 mw. light-water reactor for the government laboratory at Mol, Belgium will be many of the same features included in the Yankee design. Core design is near completion and plant construction is well along.

► **Tube Reactor**—Under the program initiated in June 1958 for the Carolinas-Virginia Nuclear Power Associates, Westinghouse is undertaking significant modification and improvement of the pressurized water reactor.

Instead of a single large pressure vessel, this reactor will use a group of relatively small tubes to hold the fuel. High-pressure coolant will circulate through these tubes. Surrounding the tubes will be a large unpressurized tank to hold the heavy-water moderator.

Work on testing and evaluation of fuel elements for this reactor will be first job tackled by the WTR at Waltz Mills. A pressure tube reactor of this type is expected to be operating late in 1962.

► **Homogeneous Reactor**—Initiated and carried out privately for  $2\frac{1}{2}$  yr. by Pennsylvania Power & Light Co. and Westinghouse, the Pennsylvania advanced reactor (PAR) now has AEC backing, also. Decision on ultimate construction of this



ARCHITECTS and ENGINEERS: Skidmore, Owings & Merrill  
GENERAL CONTRACTORS: Cheli and Anderson  
HEATING and PROCESS PIPING: Wm. A. Pepe Co.  
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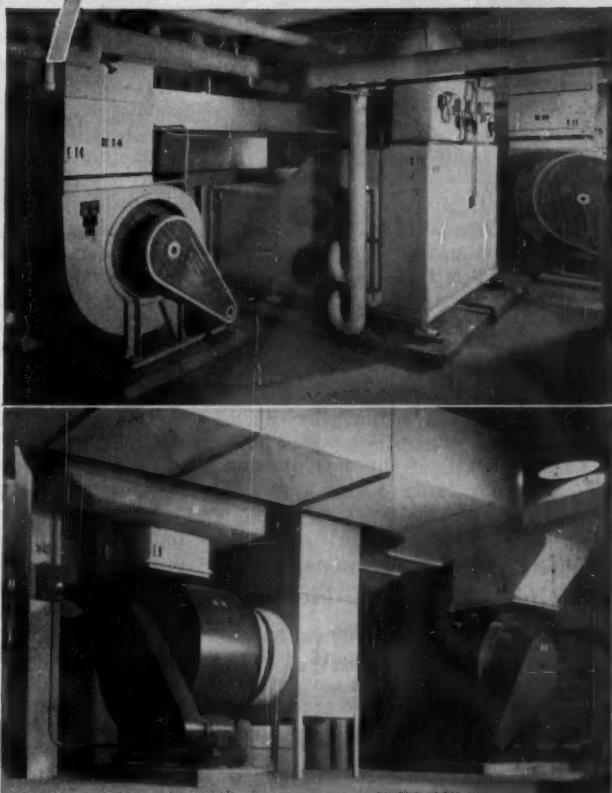
It's the new Avon Products, Inc., plant at Morton Grove, Illinois. From it flow the widely popular Avon cosmetic products. To it come members of Avon's door-to-door sales organization for training and sales meetings.

Air conditioning, thus, has a dual role to play in this structure — for employee comfort and for efficient manufacturing processes.

As for so many other noteworthy buildings, Clarge equipment was selected — some of which is shown on the right. On the job are Clarge Ready Unit ventilating sets, system fans, and Multitherm air conditioning units, including the famous Blow-Thru units pioneered and perfected by Clarge for multi-zone service.

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**both aided by Clarge "air" in  
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homogeneous reactor will be forthcoming by year's end 1959, after 4½ yr. of large-scale development.

Basically simple in concept, this reactor uses uranium and thorium oxides suspended as a fuel in heavy water.

Since the radioactive fuel circulates within loop from reactor vessel through pumps and piping to the heat exchangers and back, the entire primary system becomes radioactive. This imposes serious problems in remote maintenance and assurance of leak tightness. And, a host of slurry handling problems have faced development men.

Early in 1959, Westinghouse will start operating at Oak Ridge an in-pile test loop to check out the following points for the PAR under highly radioactive conditions:

- Corrosion-erosion effects on materials to be used in reactor.
- Handling properties of uranium oxide-thorium oxide-heavy water slurry.
- Effectiveness of recombination catalysts for preventing buildup of hydrogen and oxygen in system.
- Distribution of fission products between fuel particles and heavy water.
- Pump motor life.

Chances are that the WTR may work on this project, too, particularly if the development program leads to decision to build full-scale plant.

### Geneva Experiences, Guide to Future Meetings

More than 100,000 technical representatives from 46 nations converged this year (September 1-13) on Geneva for the second International Atoms-for-Peace Conference sponsored by the United Nations.

Plenty of evidence, revealed there, verified technological progress since the last conference three years ago; a vast pool of knowledge was included in the 2,500 papers accepted at the conference and a mammoth display of equipment complemented the technical presentation.

► **What Papers Covered** — Core of the conference was the 650

papers formally presented during the two short weeks. Attendees heard reports on the performance of the first generation of power reactors and engineering improvements to be included in reactors now being designed. Papers on fuels and fuel cycles emphasized the recent trend toward the use of slightly-enriched natural uranium fuels (uranium dioxide).

Field of health physics was presented as a challenge for further development. Conference pointed out that when we know enough about safety to enable us to reduce design safety factors, we'll be one step closer to economic nuclear power.

Papers on use of radioisotopes in process control offered an encouraging note; application of isotopes in instrumentation saved the chemical process industry \$400 million in one year.

► **Reactors Displayed** — Verifying and illustrating the technological advances reported, a variety of equipment filled the huge, 548-ft. long, 164-ft. wide exhibition building. Included in parade of equipment was a life-size model of the Shippingport pressurized water reactor showing engineering details of the power-producing core.

Other models revealed similar details of Consolidated Edison, Yankee Experimental, Experimental Boiling Water, Homogeneous (HRE-2) and Engineering Test Reactors.

Two actual reactors, Argonaut and TRIGA, sent to Geneva from the U. S., went critical and produced power. Argonaut, a training reactor, was constructed during the first week of the conference, went critical and was operated by Argonne-National-Lab. representatives during the second week.

Because of the glamour connected with it, the fusion exhibit was the center of attraction. Princeton University's Project Matterhorn, University of California's Pinch Program and Oak Ridge National Laboratory's DCX were major points of the U. S. exhibit. Russia's display fell far short of expectation; their OGRA machine never arrived, was illustrated by photographs only.

► **Guides for Future** — Conclu-

sions of the conference were many:

- We've made remarkable progress since the last conference.

- We need more conferences of this sort to coordinate research and development efforts on an international scale in the nuclear field.

- Conferences should be divided up; subject matter should be limited to a single area of knowledge, e.g., fuel technology.

- The United Nations should sponsor conferences in other fields of international concern such as rocketry and space research.

Proceedings of the conference are available from the U. N., published in a 16-volume set of books. A list of U. S. technical papers may be obtained from Office of Technical Services, U. S. Department of Commerce (see *Chem. Eng.*, Nov. 3, 1958, p. 173).

### NEWS BRIEFS

**Soda ash:** Columbia-Southern Chemical Corp. has now started up a new multimillion-dollar plant at Bartlett, Calif., to produce sodium carbonate and sesquicarbonate. New plant triples output of older plant, being scrapped, at same site.

**Synthetic rubber:** Shell-St. Go-bain, Michelin and Godfrey L. Cabot Co. with its affiliate Texas Butadiene & Chemical Corp. are forming a company to build France's first styrene-butadiene rubber plant at Berre, near Marseilles. Plant, due on stream in 1961, will make 50,000 metric ton/yr.

**Aluminum can:** Coors Porcelain Co., Golden, Colo., aiming for competitively priced one-piece aluminum aerosol cans, is perfecting a new process whereby an aluminum ingot can be converted to a slug via a continuous casting-rolling-blanking operation which would cost only "a few cents" per ingot. After slug is formed, Coors uses an already patented Italian process—Bombrini—for making one-piece can.



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DEVELOPMENTS...

## CHEMICAL ECONOMICS

EDITED BY D. R. CANNON

	Supply	Processing	Performance
<b>Natural Uranium</b>	Occurs naturally. Cheapest source of fissile material: \$5.60/gm. U-235. Stable price assured.	Can be fabricated into fuel elements under normal conditions since concentration of radioactive U-235 very low.	Since heat produced per fission is independent of enrichment, there is strong incentive to use this fuel as is. Disadvantages: low heat rating (heat output/kg. material), low temperature level, and need for a moderator.
<b>Enriched Uranium</b>	Purification work boosts fissile-material costs. At 10% enrichment, U-235 runs \$15/gm.	Uranium high in U-235 needs special processing because of small quantities and criticality considerations involved. Economies of scale not too important.	Enriched system requires more natural uranium equivalent (allowing for U-235 losses during separation via diffusion). Burnup costs/kg. U-235 about twice as high.
<b>Plutonium</b>	Must be made in reactor from U-238 by absorption of neutrons.	Toxicity requires carefully controlled processing—several times as costly as natural-uranium handling.	Possible to obtain conversion factors (ratio of fissile material produced to that consumed) greater than 1.0, and thus "breed" more fuel.
<b>Thorium</b>	Produces fissile material, U-233, only when triggered by another fissile material.	Long half-life (27 days) of fission products from thorium/U-233 cycle means big inventory tieup in cooling ponds before processing.	High conversion factors in thermal (slow) reactors—high enough to breed, perhaps. But heat rating limited since too rapid burning gives buildup of non-fissile material.

## Nuclear Fuel Costs? Nobody's Sure

There are so many angles to nuclear-fuel economics that to try and pin a price on any fuel candidate would be downright foolish. But we can check over the most important factors affecting fuel costs—fuel enrichment, reactor operation, irradiation levels, conversion ratios—and see how they are interrelated.

This is what J. A. Jukes and John Wright, United Kingdom Atomic Energy Authority, did—and did very well—in a paper delivered at the World Power Conference in Montreal this fall.

"Minimum fuel cost for any reactor system will only be obtained by a complicated process of optimization of factors," said

Jukes and Wright. "We are now in a position to know many of the problems and to assign limits within which solutions must be found."

Here, then, are some factors in nuclear fuel economics.

► **Primary Source** — Uranium 235 is the only naturally occurring material capable of producing a nuclear fission chain reaction. It is found in natural uranium in concentrations of about 0.7%, the balance being nonfissile U-238.

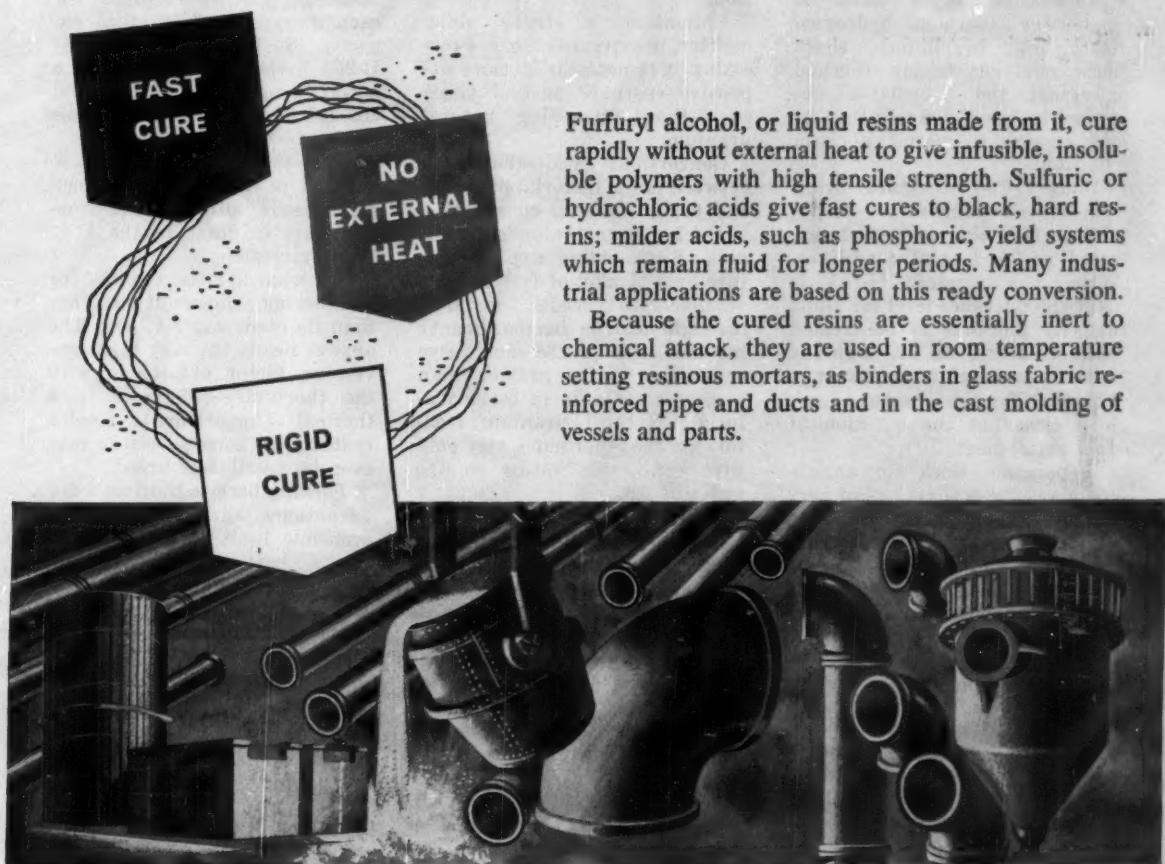
U-235 enrichment is a costly step, however. AEC's price for U-235 in natural uranium is about \$5.60/gm. (assuming U-238 has no value). At 10% enrichment, U-235 runs about \$15/

gm., and at 90% enrichment, more than \$17/gm.

► **Solid Cost Ceiling** — Natural uranium's cost figures to remain pretty stable for at least ten years even in the face of increasing industrial demand. Workable reserves have been greatly increased as a result of recent discoveries. And many of the mines throughout the world are close to writing off their capital costs while still having workable deposits.

One of the potential advantages for material enriched in U-235 is the absence of the need for a moderator. U-235 is fissile to neutrons of all energies. But when the concentration of U-238 is high, as in natural uranium,

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Furfuryl alcohol, or liquid resins made from it, cure rapidly without external heat to give infusible, insoluble polymers with high tensile strength. Sulfuric or hydrochloric acids give fast cures to black, hard resins; milder acids, such as phosphoric, yield systems which remain fluid for longer periods. Many industrial applications are based on this ready conversion.

Because the cured resins are essentially inert to chemical attack, they are used in room temperature setting resinous mortars, as binders in glass fabric reinforced pipe and ducts and in the cast molding of vessels and parts.

In addition, furfuryl alcohol and liquid resins from it are excellent wetting agents for sand, washed asbestos, glass and other materials which are frequently components of the cured resin product.

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so many fast neutrons are absorbed that an insufficient number remain to maintain a chain reaction.

► **Moderation Is a Must**—A moderator (carbon, hydrogen, deuterium, beryllium) slows these neutrons to low thermal energies; the proportion absorbed by the U-238 will then be low enough to permit a chain reaction.

Since U-235 in natural uranium is not dangerously radioactive, this fuel can be fabricated under normal conditions. When concentrated, U-235 is near the tolerance level for alpha activity and has to be treated with greater care, although the expense involved is not great.

► **Paying for Enrichment**—Let's look closer at the question of fuel enrichment.

Separation work for enrichment results in some loss of very valuable U-235 along the way. Enriched reactor systems need, therefore, more natural uranium per unit of heat output. Any increase in natural uranium's price will have greater impact on electricity costs in an enriched uranium system than in a natural uranium setup.

The same chemical processing plant can handle both natural uranium and slightly enriched uranium. But highly enriched fuel elements call for a very different kind of processing. For one thing, quantities to be handled are smaller. A second factor is the criticality consideration which limits the permissible size of many parts of the plant.

Arrayed against these deterrents are two tremendous advantages that go with enriched fuel: high heat ratings and high temperature levels. They may prove overwhelming.

Plutonium is a synthetic fissile material; it is manufactured in a reactor from U-238 by absorption of neutrons. Irradiated uranium fuel elements normally contain four isotopes of plutonium, the relative proportions depending on the amount of heat extracted from the reactor (the irradiation level).

► **Indifferent Isotopes**—Two of these isotopes are not fissile to slow, or moderated, neutrons. Since these same two isotopes may comprise better than 20%

of all plutonium at irradiation levels above 4,000 megawatt days per ton of fuel, a moderator may retard plutonium utilization.

Plutonium, a strong alpha emitter, is extremely toxic. Processing it is necessarily more expensive—perhaps several times so—than processing natural uranium.

Conversion ratio—the ratio between fissile material produced and fissile material consumed—is the key to plutonium's usefulness. Surrounding a plutonium core by a blanket of fertile (convertible to fissile material through neutron bombardment) material like U-238 may give conversion ratios greater than one, or a net gain in fissile material. Natural uranium reactors, on the other hand, may only give conversion ratios on the order of 0.8.

► **Big Burnup**—Fuel costs can be kept low by high conversion factors. And the higher the factor, and the lower the enrichment, the higher the over-all utilization of fuel.

Yet the extent of net production of new fissile material, or of "breeding" as it's sometimes called, depends as much on the efficiency of chemical processing outside of spent fuel (with return of usable fissile material) as it does on the conversion ratio.

And the usefulness of the net gain in fissile material depends on the heat rating of the fuel: the rate of fission, or the rate of heat production per kilogram of fuel. The higher the rate of fission the higher the production of fissile material.

► **Double Time**—Thus, it isn't the conversion ratio that tells the whole story of the breeder-reactor fuel. It is the double-time in the whole system, the time in which the fissile material doubles. (This may take several years.)

Thorium, like U-238, is not fissile but fertile. It produces fissile U-233 when irradiated by neutrons from a fissile material.

The initial cost of thorium—about the same as that for natural uranium—is not important in the fuel costs for a thorium/U-233 fuel cycle. It is overshadowed by the cost of fissile ma-

terial to trigger the system, and by processing costs.

► **Wait for Trigger**—In most systems, at least 1 kg. of fissile material will be required for each megawatt of installed capacity. So before the thorium/U-233 cycle can be used in a power program, a substantial amount of fissile material—tons per year—will be needed.

Thus, thorium is a poor bet to be used in quantity for a good many years, although the prospects are brighter in the U.S. than overseas.

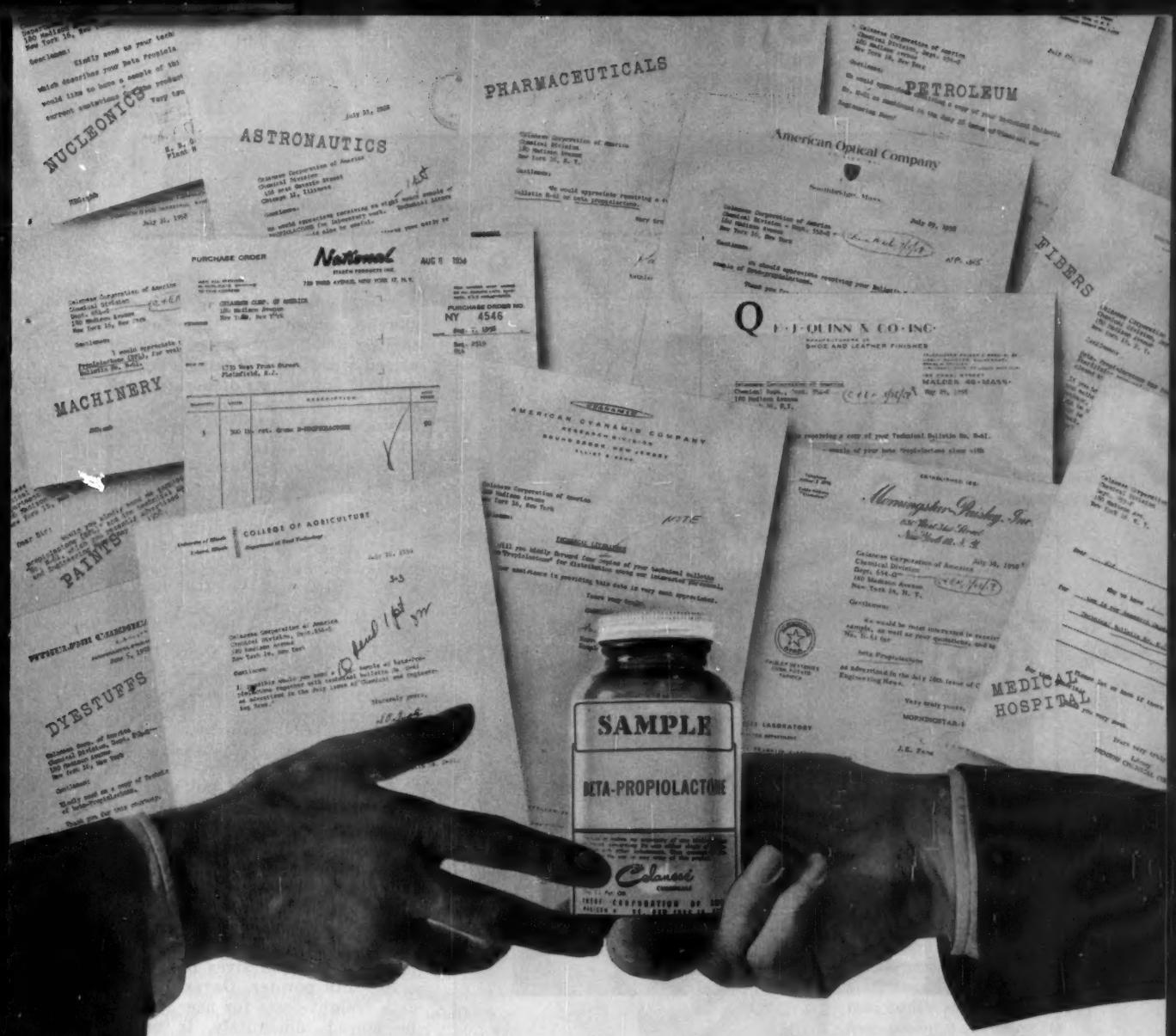
But what are the reasons for considering thorium at all, other than its ready availability? The answer lies in the very high conversion factor obtainable with the thorium/U-233 cycle in a thermal (unenriched) reactor system. In some cases it may even be possible to breed.

Turning back to thorium's disadvantages again, we find an economic limit set on the heat rating (heat output/kg. of fuel) attainable in a thorium reactor. Under neutron bombardment, thorium first forms non-fissile protoactinium (Pa-233) which decays very slowly (27-day half life) into fissile U-233.

► **Slow Burn Is Best**—Thus, any rapid burning of thorium fuel yields a corresponding buildup of Pa-233 which, if subjected to too intensive a neutron bombardment, may be transformed into Pa-234 which decays into nonfissile and unusable U-234. It simply doesn't pay to step up a thorium reactor's heat rating to the point where too much Pa-233 has too little chance to decay to useful U-233.

Pa-233's long half-life also poses a big inventory problem in the form of fissile material in cooling ponds awaiting processing and recycle to the reactor. The processor of spent fuel from a thorium reactor must wait longest, not for fission products to lose their radioactivity,\* but for Pa-233 to decay to U-233. Assuming a 27-day half life, the thorium fuel might have to remain in the cooling pond for six months to a year.

\* Most critical fission product in spent fuel from most reactor systems is iodine 131, with a 8-day half life. To cut I-131's radioactivity to one-thousandth of its initial level calls for a cooling-off period of some ten half lives, or 80 days.



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DEVELOPMENTS . . .

## CHEMICAL PRODUCTS

EDITED BY FRANCES ARNE



### Plastic Honeycomb Houses Pioneer Instruments

Engineers at Cape Canaveral place top section of the conoidal-shaped satellite package, instrument-carrying payload of moon-probing space rocket, Pioneer I. Top, bottom and middle section were formed with Hexcel reinforced fiberglass plastic honeycomb.

Though 8 sq. ft. of the material went into the 29-in. dia. unit, it only weighed 15 oz. Honeycomb in sandwich form, such as was used in Pioneer I and in Pioneer II, has highest strength to weight ratio of any material known.—Hexcel Products Inc., Berkeley, Cal. 76A

### Catalyst

For hard-to-hydrogenate fats and oils.

A new, nickel-on-kieselguhr catalyst for selective hydrogenation of carbon-to-carbon double bonds of vegetable oils

and animal fats has been developed.

The new, dry-reduced, oil-suspended catalyst, called G-53, shows considerable promise for treatment of inedible oils such as fish oils for soaps and other oils with unusual contaminants.

Already available in commercial quantities, the new catalyst will be competitively priced with other catalysts for similar applications. Laboratory studies and plant tests indicate that the effective service life of the G-53 is from 50 to 100% longer than other catalysts of the type. It is also said to have greater first-use selectivity.

The new catalyst will be furnished in granular form, 100% passing through a 4-mesh screen. It has a bulk density of 37 lb./cu. ft.—Chemetron Corp., P. O. Box 337, Louisville, Ky. 76B

### Spray Dried PVAc

Powdered emulsion for paints, cements, adhesives.

A new dehydrated polyvinyl acetate emulsion, called Darex ESD, can be used in place of liquid vinyl emulsions wherever presence of water is undesirable. It is expected to find wide use as an additive in dry mixes of specialty portland cements, as a vehicle for industrial paints, as an adhesives base.

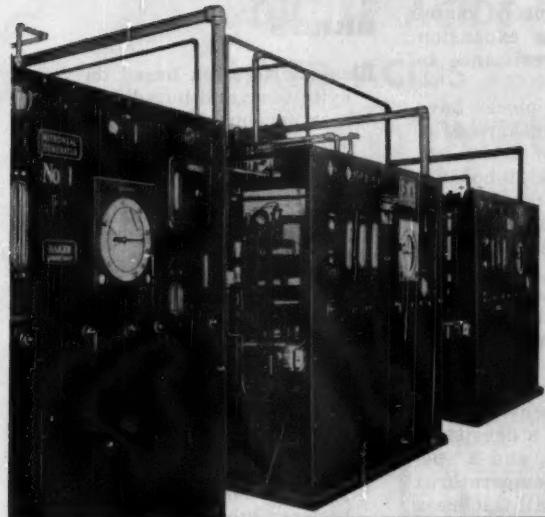
A white powder, Darex ESD cuts freight costs for uses, can be stored indefinitely, is unaffected by freezing, and can be mixed as needed where small batches are prepared at a time. Cost is 47¢/lb., truckload quantities.—Dewey & Almy Chemical Div., 62 Whittemore Ave., Cambridge, Mass. 76C

### Pelleted Fertilizer

Permits directly-aimed fertilization of seedlings.

Now exploring markets in orchard plantings, home gardens, etc., Mora Chemical Corp., Seattle, has been licensed as sole manufacturer of a newly developed fertilizer pellet. Pellets can be placed just where they're wanted; there's no waste as from fertilizer when broadcast. Costs of fertilizing

for the most efficient  
production of  
oxygen-free gas



**NITRONEAL® GAS GENERATOR**

... provides by far the most economical and efficient method for the production of pure nitrogen—completely free of oxygen—and with hydrogen content precisely controlled at any desired percentage between 0.5% and 25%. Nitrogen is supplied at a fraction of cylinder supply cost.

The Nitroneal Generator is automatic except for startup, with no need for operating personnel. The unit performs instantly, efficiently anywhere in the range of from 25% to 100% of rated capacity. Installation requires only a 110 volt line, water, air, ammonia lines and drain facilities. Units can be supplied in capacities of 100 cfm to 10,000 cfm. . . . The catalyst lasts indefinitely—maintenance costs are practically nil. Write for complete catalog material and data.

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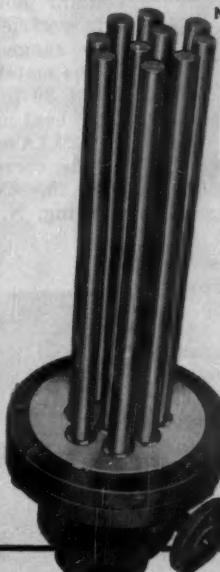
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**spinnerettes  
for synthetic fibres**

Precious metal and stainless steel spinnerettes with rigidly controlled hardness and grain characteristics are available in standard and special designs. All surfaces are mirror-like, including walls of finest holes, for maximum protection against corrosion to assure trouble-free production. Write for "Spinnerettes" brochure.

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**platinum clad  
sheet, tubing  
and wire**

Platinum clad sheet, tubing and wire make it possible to incorporate all of the important corrosion-resistant qualities of the noble metals in equipment, at minimum cost. The process guarantees continuous pin-hole-free platinum cladding to withstand high temperatures without oxidation.

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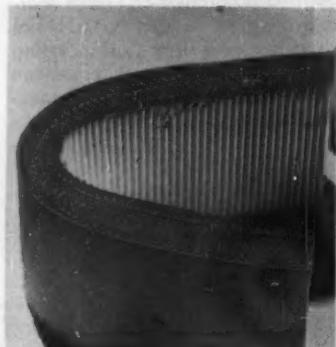
## CHEMICALS . . .

seedlings with pellets run to less than \$10/acre.

The new pellet is about 1-in. in diameter and contains slowly soluble urea formaldehyde resins and superphosphate. It is dropped in the hole when a seedling is set out and dissolves so slowly it causes no burns.

Seedlings planted early last year with pellets produced a 43% increased growth in 1957 and a 56% increase in 1958.—Crown Zellerbach Corp., Camas, Wash.

76D



### Ceramics

Thin-walled ceramics in lightweight honeycomb structures stand 1,800 F.

Extremely thin-walled ceramics formed into lightweight honeycomb structures capable of operating at high temperatures have been introduced.

These materials, made by the new Cercor process, can withstand temperatures to 1,800 F. with virtually no thermal expansion, and can operate continuously at 1,290 F. At these temperatures they are resistant to oxidation and corrosion. They can withstand extreme thermal shock.

The extremely low expansion at high temperatures and high surface area of Cercor process materials indicate their future use in gaseous heat exchangers, as catalyst supports and as structural materials for use at elevated temperatures.

It is possible to build Cercor structures having a wide range of shapes and properties. The base material can be any of a large number of ceramic compositions. Pyroceram, high

strength crystalline material invented by Corning, is used as one of the base materials for available Cercor pieces.

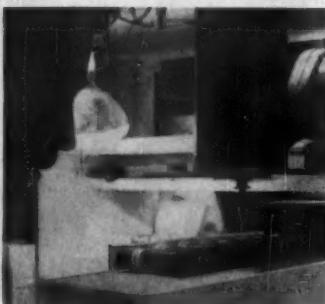
Disks 20 in. in diameter and 3 1/2 in. thick have been made by the Cercor process. A protective rim for the disk is formed by a tough coating of special material with matching expansion and equally high resistance to temperatures.

Available Cercor pieces have a compressive strength, parallel to the channels, of 2,000 psi. Surface area of the 20-hole/in. corrugated structures is 1,500 sq. ft./cu. ft. of material.

Of the total face area, 75 to 80% is open space. Hole sizes of Cercor pieces are approximately 0.095 in. long and 0.045 in. high. It is believed that the cellular holes can be formed into a variety of shapes with a wide range of dimensions.

The material has a density of about 30 lb./cu. ft. and a specific heat (room temperature) of 0.20. Average wall thickness of the corrugated structure is 0.005 in.—Corning Glass Works, Corning, N. Y.

78A



### Curing Agents

Anhydride curing lengthens epoxy pot-life, permits automated filling, above.

A major advantage of curing epoxies with anhydrides, rather than amines, is that the formulation has longer pot life permitting automated production set-ups like that for filling resistor shells, above.

Reservoir shown holds enough formulation for entire day's production. At experimental arrangement of Electronic Plastics Corp. Anhydride used is

hexahydrophthalic. With amine-cured resin, on the other hand, fresh batches would have to be made up every 15 min.—Allied Chemical, National Aniline Div., New York, N. Y.

78B

### BRIEFS

Elastomeric latex based on vinyltoluene and butadiene has been developed for upholstery and rug backing, for modifying and sometimes replacing natural or chloroprene type latexes in resilient hair padding. Called Latex 2582, it has superior resistance to metal staining, is lighter in color, lower in odor.—Dow Chemical, Midland, Mich. 78C

Fluoroalcohols called C7, C9 and C11 have fluorine content varying from 68.6 to 71.4%. The new compounds hold promise as intermediates in plastics manufacture, elastomers, lubricants, nonflammable hydraulic fluids. Developmental price is \$40/lb.—Du Pont Co., Wilmington, Del.

78D

Broad-spectrum antibiotic called Actinobolin has just been isolated in the laboratory. It shows activity against a number of infections and experimental cancers.—Parke, Davis & Co., Detroit, Mich.

78E

Perfluorobutene-2 is the first perfluoro organic monomer to be made commercially available. A gas boiling at 0 C., it copolymerizes readily with other monomers and is being studied as a modifier in the development of special polymers.—Halocarbon Products Corp., Hackensack, N. J. 78F

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about any item in this department, circle its code number on the

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postcard (p. 177)

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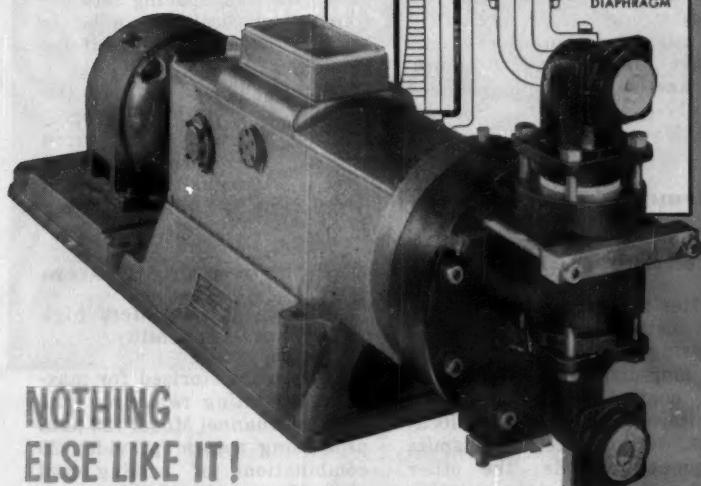
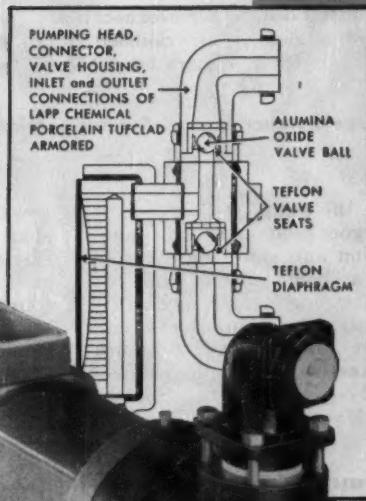
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COMPLETELY NON-METALLIC CONSTRUCTION

AND

NO STUFFING BOX TO LEAK



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Lapp Pulsafeeder is the combination piston-diaphragm pump for controlled-volume pumping of fluids. Reciprocating piston action provides positive displacement. But the piston pumps only an hydraulic medium, working against a diaphragm. A floating, balanced partition, the diaphragm isolates chemical being pumped from working pump parts—eliminates need for stuffing box or running seal. Pumping speed is constant; variable flow results from variation in piston-stroke length—controlled by manual hand-wheel, or, in Auto-Pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable.

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with typical applications, flow charts,  
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tions. Inquiry Data Sheet included  
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DEVELOPMENTS ...

## PROCESS EQUIPMENT

EDITED BY C. C. VAN SOYE

### Latest Developments



Gas Analyzer

Continuously measures concentration of any one gas in a mixture. 152A



Density Instrumentation

Continuously monitors density of stagnant or flowing liquids. 150B



Respirator

Removes heat from air destined for user's lungs. 148A



Bulk Container

Ideal for storing, shipping granular products. 151A

Page number is also Reader Service Code Number



Flexible Hose

Combines properties of Teflon, stainless steel.

New Springfield "400" flexible Teflon hose assemblies, designed with high temperature and corrosion resistance for processing applications, are available in diameters from  $\frac{1}{2}$  to 2 in. Minimum bend radius is  $3\frac{1}{2}$  times the equivalent tube size; working temperatures range from -65 to 400 F.

Each hose assembly consists of three layers—helically-wound Teflon on the inside, an overlay of Teflon-coated Fiberglas tape and an outer protective coating of braided stainless steel wire. Prior to application of the wire

braid, the compound inner tube undergoes convolution, compression and sintering steps to give a homogeneous unit of great strength and flexibility. A swaging process locks end fittings onto the hose to assure permanent leakproof connections. — Titeflex, Inc., Springfield, Mass. 80A

### Telemetering Systems

For monitoring data at scattered locations.

After two years of successful field testing, two types of telemetering systems are available for long-distance transmission and control of process data monitored at scattered locations. One system transmits frequency signals; the other sends pulses.

Heart of the frequency-type system is a voltage-modulated oscillator that produces a square-wave output. Frequency of this signal is directly proportional to input current signal from the sensing element. At the receiving end of the system, another transducer converts frequency signals back to current.

Each pulse-type telemetering system consists of a recorder at the point of measurement, a

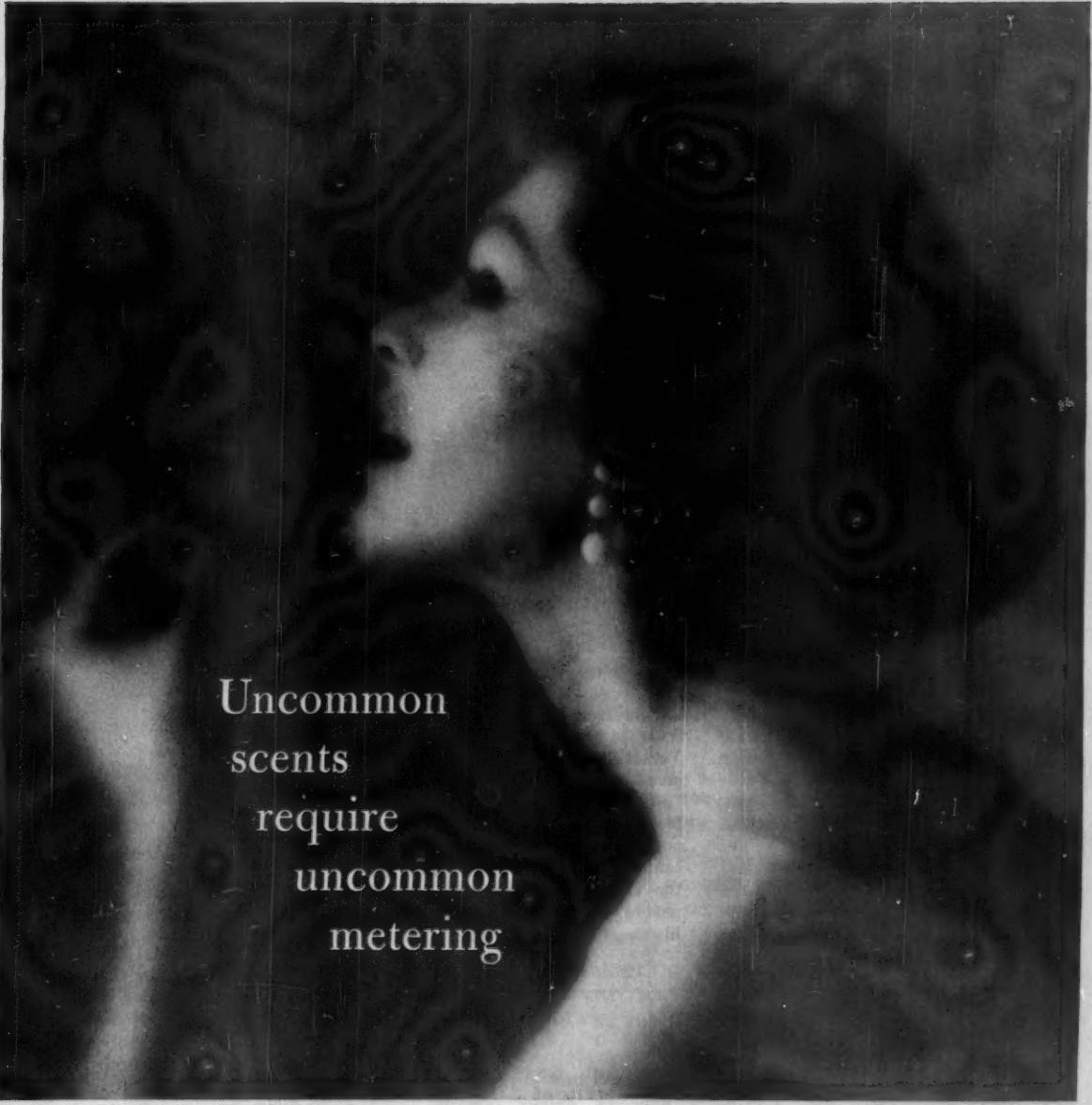
power pack for signal transmission and an instrument for receiving signals at the opposite end of the line. Spacing between source and receiver can be as high as 100 mi. Process intelligence leaves the source as a series of delayed pulses, the time length of each pulse representing the value of measured variables. — Brown Instrument Div., Minneapolis-Honeywell Regulator Co., Phila., Pa. 80B

### Data Processing System

Standard item offers high accuracy, reliability.

Fully transistorized for maximum operating reliability, the new 100-channel Model 123 data processing system provides 25 combinations of scaling and zero offset, high or low alarm limits, and square root extraction for flow computation. Scanning rate is one point per second. A pinboard simplifies programming.

Production of Model 123 as a standard item, rather than as a customized system, keeps initial cost down. Yet, accuracy is claimed to be comparable to the manufacturer's Model 112 computer-data processing system. — Beckman Instruments, Inc., Systems Div., Anaheim, Calif. 80C



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uncommon  
metering

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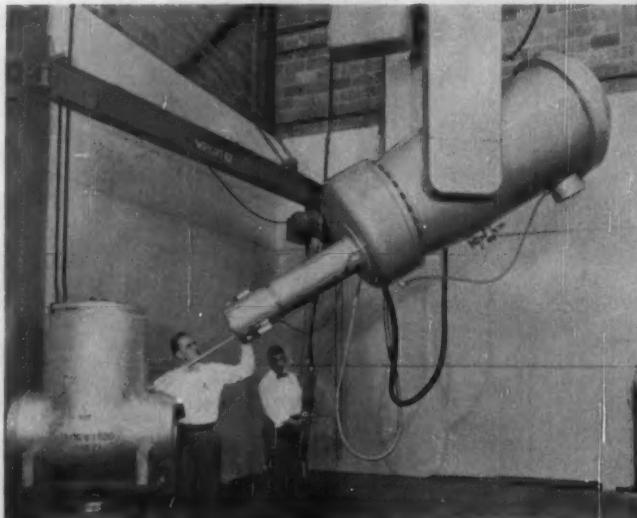
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THE PEOPLE WHO KNOW AND CONTROL FLOW



### New Gun Keeps Tabs On Quality. Ready, Aim, X-Ray!

In place and ready for radiographic inspection, this 4,500-lb. casting of a pressure-seal gate body is about to receive twenty 1-min. exposures from a 2-million-volt Van de Graaff X-ray generator. Part of American Chain & Cable's recently unveiled non-destructive testing facilities, the huge X-ray unit and its working companion—a 10-Curie cobalt-60 source—are

housed in a massive building having concrete walls ranging from 24 to 48 in. in thickness. Versatility of the X-ray unit stems from use of a modified 7½-ton Wright bridge crane to jockey the accelerator tube into position. A hand-driven turntable permits easy rotation of the casting prior to each exposure.—American Chain & Cable Co., Bridgeport, Conn. 82A

### Air Compressors

High-capacity units deliver oil-free air.

Now available with capacities of 6,700, 10,000 and 19,250 cfm., new Twin-Air rotary-screw air compressors offer many advantages to the process industries, according to company officials. Substantial maintenance savings are possible because the twin rotors never quite contact each other. In addition, the no-contact design eliminates need for lubricants, thus assuring oil-free air delivery.

Twin-Air compressors draw air into the front end of their screw assemblies. As the lobes of the parallel-mounted screws

rotate into each other's grooves at the rate of 3,600 rpm., air spirals forward into increasingly smaller interlobe volumes. Finally, the screws force air through the discharge port at pressures ranging up to 120 psi.—Atlas Copco, N. Y., N. Y. 82B

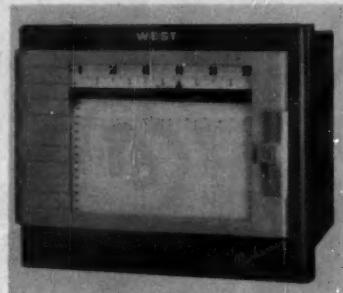
### Temperature Controller

Adjusts heating - medium flow to hold temperature.

Latest additions to one manufacturer's line of control instrumentation are two pneumatic temperature controllers, one an indicating model and the other a recording unit. In operation, the units vary flow of steam,

water, gas, or other heating media through an air-operated throttling valve in direct proportion to temperature changes sensed by a mercury-expansion thermal element. Accurate and sensitive, both controllers come in 10 styles covering an over-all temperature range from -30 to 1,100 F.

Model RVA, the recorder-controller, has a 12-in. circular chart, either spring- or electrically driven. The indicating controller, Model IVA, permits easy viewing of temperatures on a wide, high-visibility scale.—The Partlow Corp., New Hartford, N. Y. 82C



### Strip-Chart Recorder

Offers tubeless operation and low maintenance.

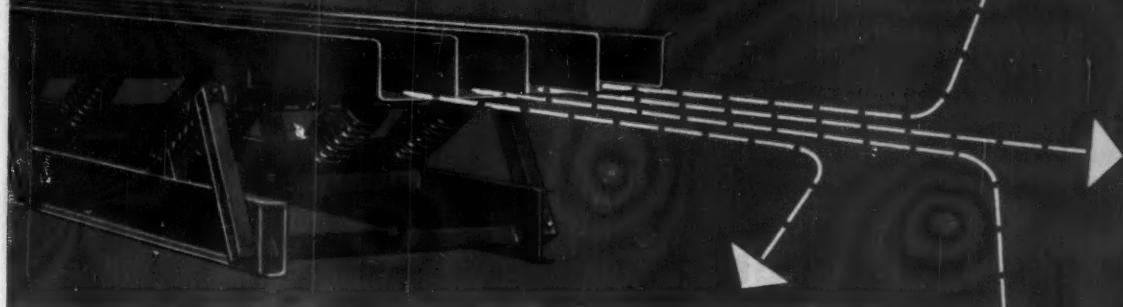
First of the Model "M" Series, the new Marksman strip-chart potentiometer recorder uses a printed-circuit and transistorized amplifier—no vacuum tubes. Some of the unit's other features include automatic standardization, thermocouple break protection, cold-junction compensation, chart tear-off strip and adjustable chart speeds.

Marksman recorders are claimed to be extremely sensitive (0.1% or better) and accurate ( $\pm 0.25\%$ ). They will record any variable that can be transformed into an electric signal via transducers—temperature, pressure, pH, etc. Input can be either 115, 208 or 230 v.—West Instrument Corp., Chicago, Ill. 82D

**Respirator**  
and other equipment news  
on page 148.

# DISTRIBUTE and CONTROL FLOW of MATERIALS to

- SCREENS
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● **Low Headroom, Distant Delivery**—One Carrier Conveyor with a single drive and less than 30 inches of headroom distributes materials to a line of receiving equipment up to 500 feet long! Capacities up to 500 TPH.

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channels prevent intermixing. Dust covers and flexible connections can also provide completely dust-free, sanitary operation.

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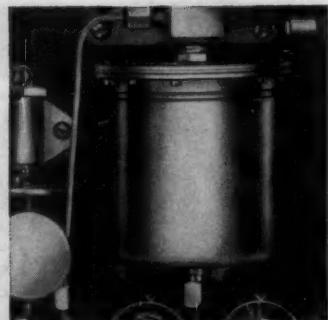
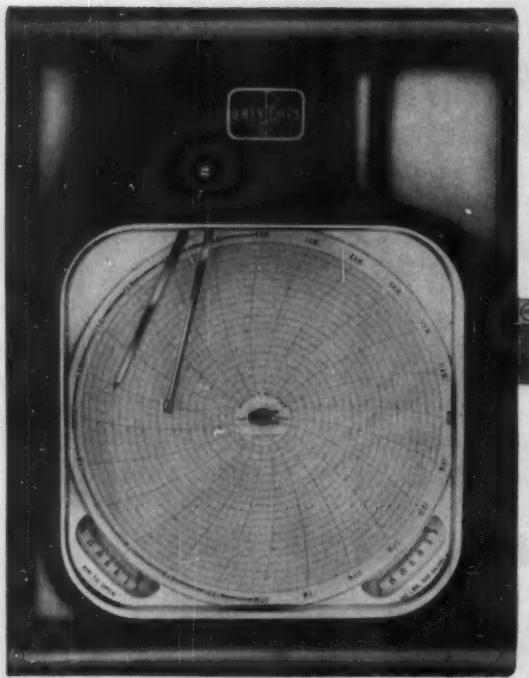
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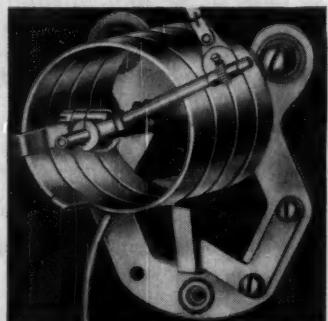
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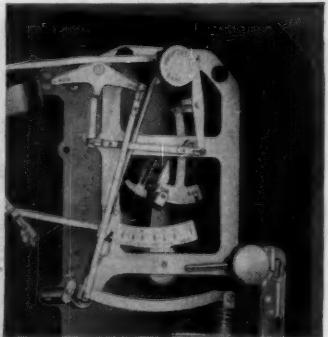
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He'll catch on quick to the Bristol Series 500 Controller without a complicated, lengthy training period.

In fact, your plant can have Bristol Series 500 Controllers, even if you don't have a formal instrument department at all. Many small instrument users are doing this today. Yet the 500's performance is such that one of the largest, most widely known chemical companies in the country just bought seventy 500's for its exacting processes.

Here are the big reasons the 500's a favorite with all instrument users, both large and small: (1) Basic simplicity of the operating mechanism; (2) Bristol measuring elements insure the utmost accuracy.

Another big simplification: You can exactly calibrate the Series 500 Controller with only one single adjustment, even after complete disassembly and re-assembly with replacement of parts.

Get complete data on Bristol Series 500 Pneumatic Controllers now, before you order another instrument. Write for bulletin A 130, The Bristol Company, 109 Bristol Road, Waterbury 20, Conn.

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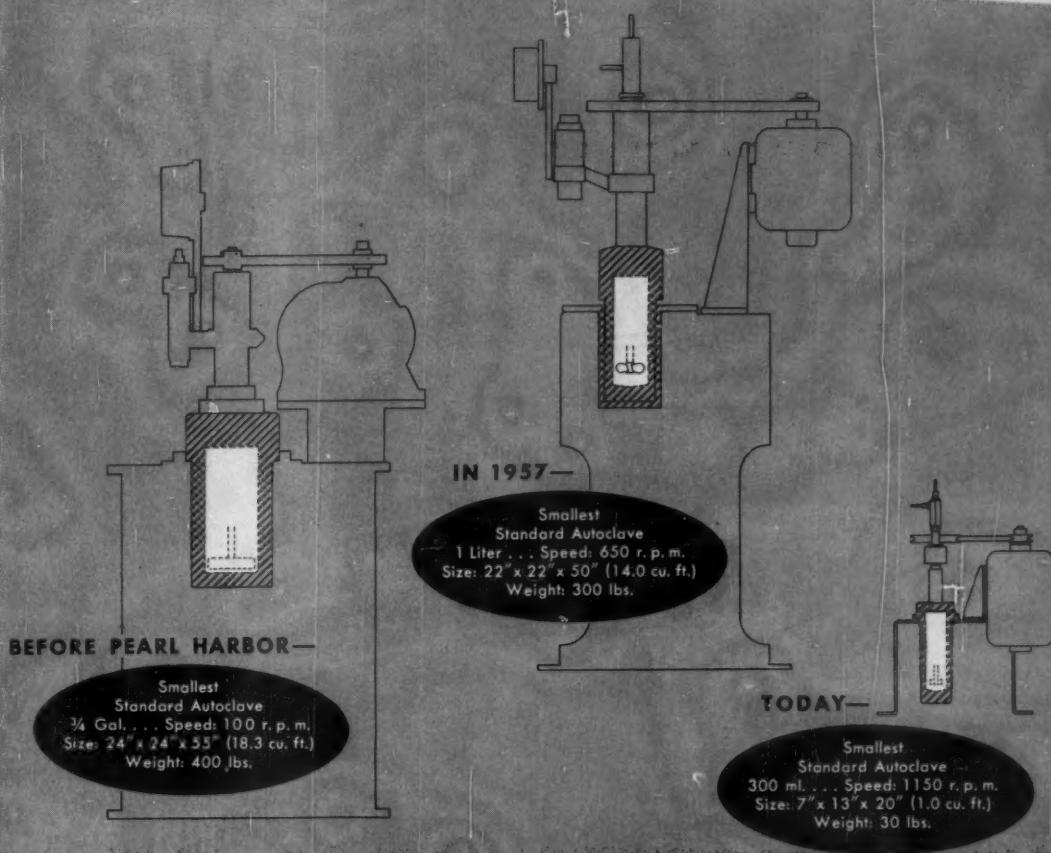
**These operating modes:**

1. Fixed narrow band (on-off)
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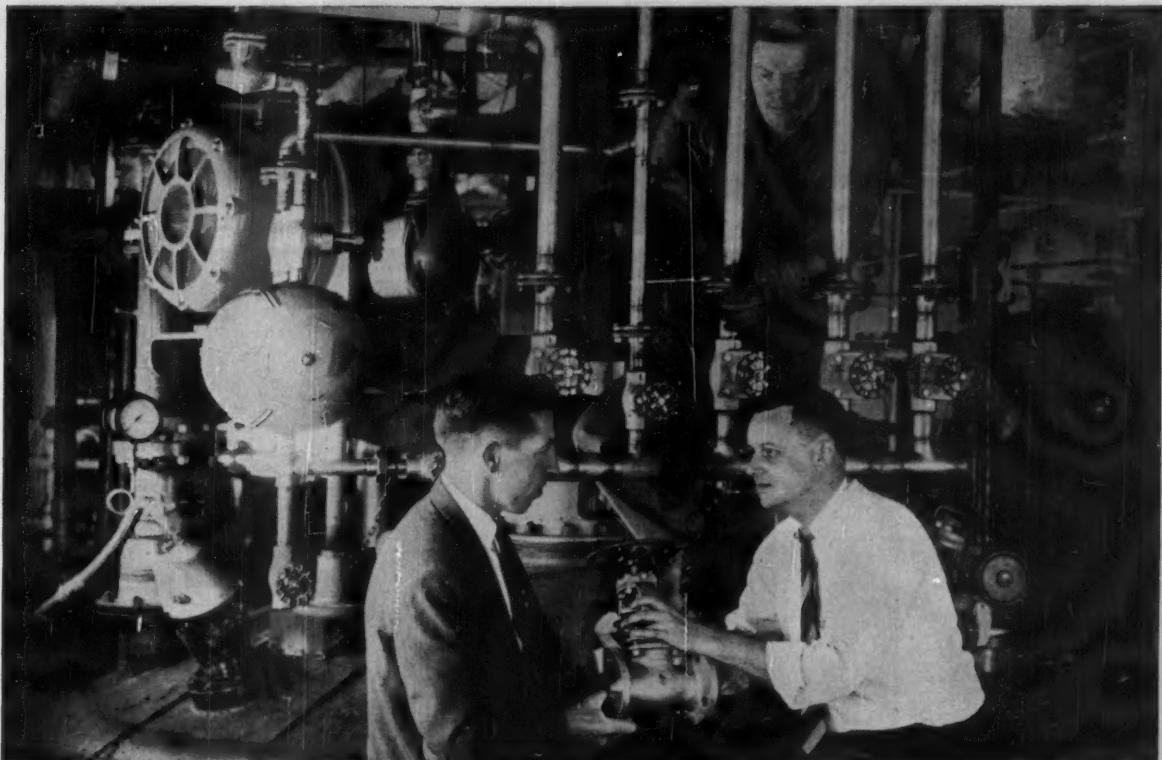
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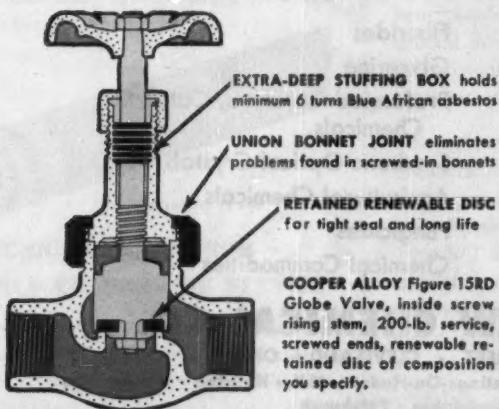
Right, Edgar A. Stoddard, Project Engineer, Dewey & Almy Chemical Division, W.R. Grace & Co., Cambridge, Mass. Left, Jack O'Donoghue, All Stainless Inc., Cooper Alloy distributor, Allston, Mass. Background, C. W. Stuart of Thomas G. Gallagher, Inc., Somerville, Mass., contractors.

## STODDARD of DEWEY & ALMY

### Tells Why He Specifies Cooper Alloy for Stainless Valves and Fittings

Q. Mr. Stoddard, why does Dewey & Almy, a leading manufacturer of chemical and plastic specialties for industry, use stainless valves and fittings?  
 A. For two reasons of major importance in the chemical processing industry: purity of product, and resistance to corrosion.  
 Q. Why Cooper Alloy?  
 A. For three reasons equally important: ease of maintenance, thanks to Cooper Alloy's unique design features; availability; and distributor service.  
 Q. What design features are you referring to?

A. Well, take these Cooper Alloy renewable-disc globe valves on these monomer lines. We like the ease of operation and low maintenance. And of top importance, these valves eliminate serious vapor leakage we once had.  
 Q. What about availability and service?  
 A. Outstanding. In fact, All Stainless Inc., the local Cooper Alloy distributor, has even gone to the trouble of taking over most of our stocking problems, by putting in a complete representative stock of Cooper Alloy RD globe valves. That's what we call service!



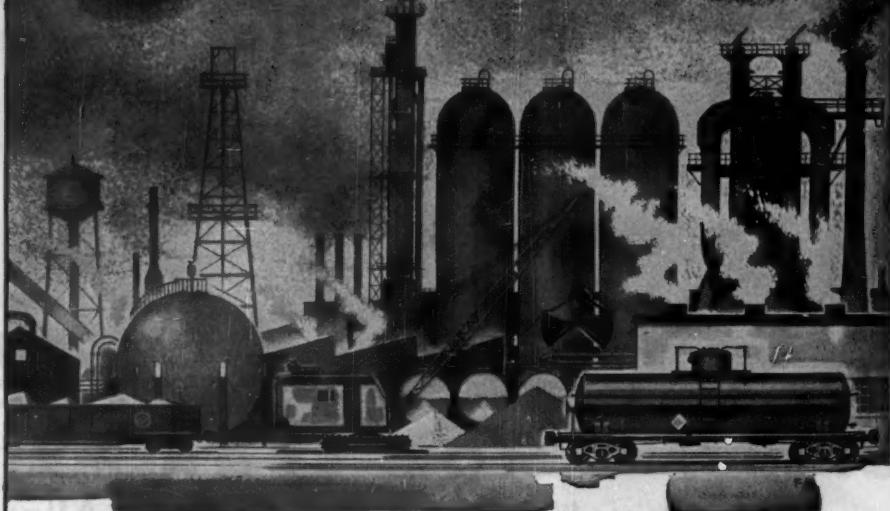
**A VALVE DESIGNED FOR STAINLESS!** The Cooper Alloy valve is not an adaptation of earlier brass and iron patterns. Cooper Alloy, with over 35 years of experience in handling stainless steel, created a valve designed to be cast in stainless! Check the Special Design Features shown at left.

As the little CA man below is saying: "You can tell a Cooper Alloy Valve as far as you can see it!" Write today for your copy of our folder "Design Factors In Stainless Steel Valves." The Cooper Alloy distributor near you will be glad to show you the complete line of Cooper Alloy valves and fittings, and their advantages. He can serve you promptly from local stocks.

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Food  
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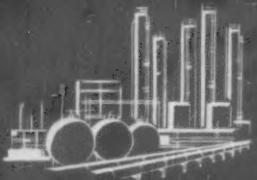
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# WOLVERINE TUBE

## Items of Interest to the Processing Industry



PUBLISHED BY WOLVERINE TUBE DIVISION

### Use TRUFIN TYPE S/T in both Old and New Units

Wolverine Trufin Type S/T is a completely versatile heat exchanger tube—is equally at home in new units or old. When new heat exchangers and condensers are designed around Type S/T they are smaller and more compact because its integral fins increase heat transfer surface—handle more BTU's per foot of tube.

The net result is a substantial saving in direct tube costs as well as in labor and the materials that go into headers, baffles and shells.

When used for retubing purposes Trufin Type S/T steps up the capacity of existing equipment because its greater surface area packs more heat transfer surface into the same size shell.

Also of major importance when retubing is the fact that Trufin Type S/T is completely interchangeable with the plain tube it is designed to replace. During the finning process the ends of the tube are left without fins so that the O.D. of the plain end is slightly larger than the O.D. over the fins.

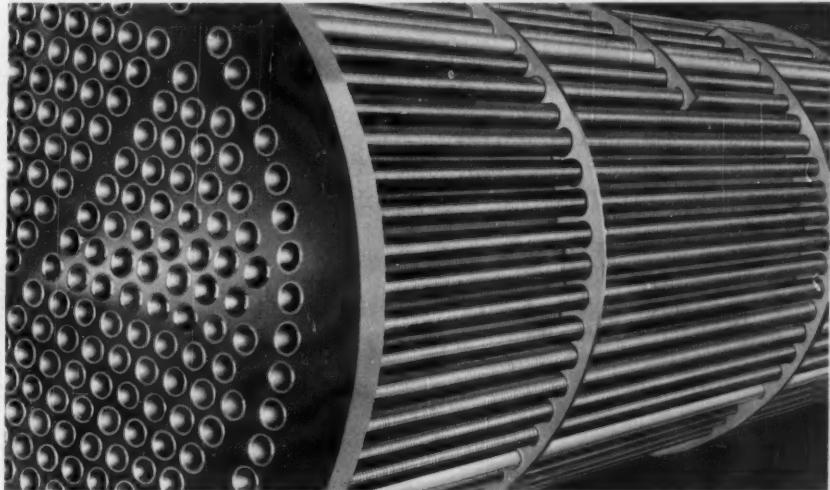
Because of this, Type S/T can be inserted into the bundle and rolled directly into the tube sheet in the regular manner using only standard tools and retubing techniques.



Wolverine Trufin Type S/T

### TECHNICAL HELP FROM FIELD ENGINEERING SERVICE

Always available to help customers solve problems in alloy selection, design, corrosion, etc., are the skilled members of Wolverine's Field Engineering Service.



### HOW WOLVERINE TRUFIN® TYPE S/T SAVED 17 MILES OF TUBE FOR A LARGE EASTERN FABRICATOR

BY ERNEST DODD

No matter how you look at it 17 miles of condenser tube adds up to a lot of tube—and, when those 17 miles represent the amount of tubing saved in one installation then it becomes a significant figure indeed.

This substantial saving in direct tube costs occurred recently when engineers for a large eastern fabricator designed heat transfer units for an M.E.K. plant around Wolverine Trufin Type S/T—the original, integrally finned tube for shell and tube equipment.

The units included condensers, coolers, reboilers, and product heater, etc. From previous experience their engineers knew that with Wolverine Trufin Type S/T they could design units with smaller shells and still realize maximum throughput, save space by obtaining more compact arrangements and greatly reduce the amount of tubing required.

For example, had the units been tubed

with prime surface tubing approximately 225,000 feet would have been required. To OBTAIN EQUIVALENT HEAT DUTY only 134,000 FEET OF WOLVERINE TRUFIN TYPE S/T WAS NEEDED—a saving of 91,000 feet or approximately 17 miles of heat exchanger tube.

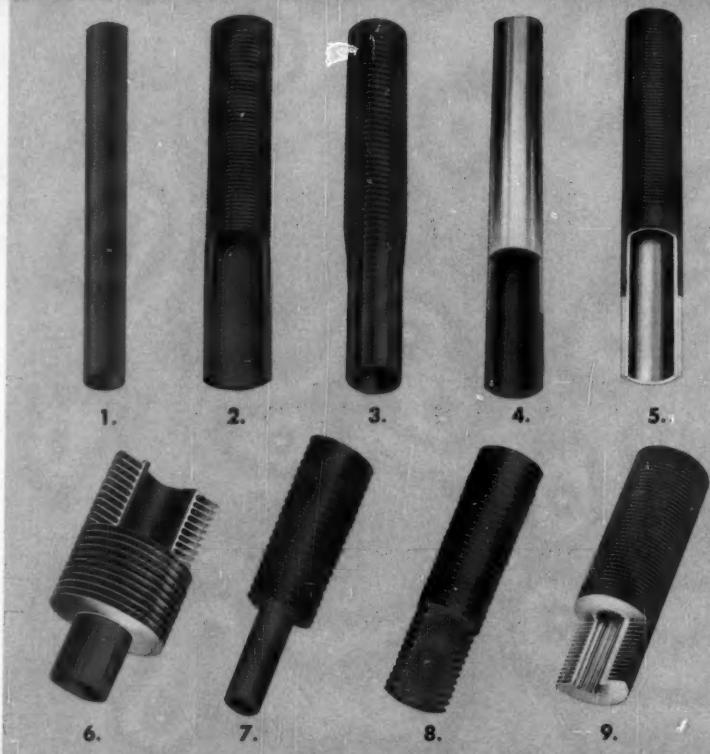
Wolverine Trufin Type S/T is available in a wide range of sizes in copper, copper alloys, aluminum, and steel. In addition to the installation described above it is ideally suited for such operations as crude stills, reformers, cat crackers and alkylation plants, etc.

Next time you're considering new equipment, specify Wolverine Trufin Type S/T. If you're retubing, Trufin Type S/T can increase the capacity of existing equipment by as much as 70%—depending on the type of service in which it is used. Either way you can't lose. Write—TODAY—for complete information.

# CONDENSER TUBES FOR EVERY JOB

From its years of experience in the heat transfer field Wolverine Tube has developed a condenser tube lineup designed to meet every need. Engineers can, for example, specify prime surface tube . . . integrally finned (Wolverine Trufin) or duplex tubing . . . all in a wide range of sizes and alloys. Next time you specify heat exchanger tubing remember that Wolverine Tube can meet **ALL** your needs.

1. PRIME SURFACE TUBE
2. WOLVERINE TRUFIN TYPE S/T
3. WOLVERINE TRUFIN TYPE W/H
4. PRIME SURFACE DUPLEX TUBE
5. WOLVERINE TRUFIN—DUPLEX
6. WOLVERINE TRUFIN TYPE L/C
7. WOLVERINE TRUFIN TYPE H/R
8. WOLVERINE TRUFIN TYPE H/A
9. WOLVERINE TRUFIN TYPE I/L



## TECHNICAL HELP FOR EVERY JOB



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Evanston—DA 8-8616  
Chicago—PO 4-7412

If you're having trouble with heat transfer problems . . . such things as equipment design or alloy selection you can obtain expert help real fast. Just get in touch with one of Wolverine Tube's Technical Sales Representatives. They're as close as your telephone and because of their specialized training are fully qualified to help you solve the most difficult problems. Call on them next time you need help.

CALUMET & HECLA, INC.  
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Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA  
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Wolverine Trufin is available in Canada through  
the Unifin Tube Division, London, Ontario.





**PETROCHEM  
ISOFLOW FURNACES**  
*supply process heat for*  
**TEXAS BUTADIENE**  
and **CHEMICAL Corp.'s**  
**86,000 TON**  
**BUTADIENE PLANT**

*...in fact, approximately 85%  
of all new butadiene capacity  
in the U.S. is processed through  
Petrochem "Isoflows."*

The unique design and operating features which have led to the wide acceptance of Petrochem Isoflow Furnaces for butadiene production, catalytic reforming and other petroleum, petrochemical and chemical processes include:

- Uniform Heat Distribution • Maximum Fuel Efficiency • Low Pressure Drop • Low Maintenance
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*There's a Petrochem Isoflow Furnace for any duty, temperature and efficiency.*

Petrochem Isoflow copyrighted internationally

## **PETROCHEM-ISOFLOW FURNACES**

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

**PETRO-CH2M DEVELOPMENT CO., INC. • 122 EAST 42nd St., New York 17, N. Y.**  
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# NEW from Standard Oil

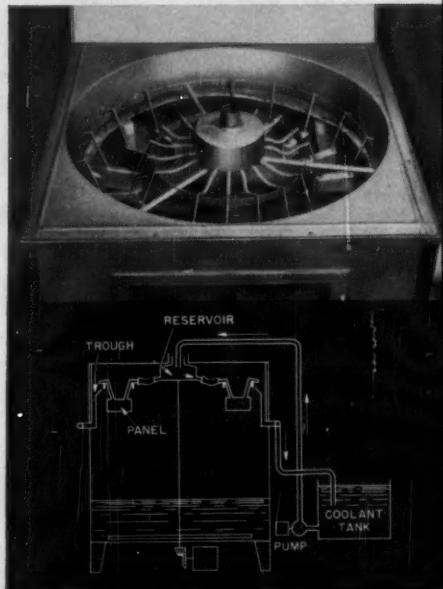
Corrosion steals \$5.5 billion from industry annually. Standard Oil is in the forefront of the fight to control this loss. Standard's research scientists have developed a new method for measuring the effectiveness of rust preventives. This new test takes less than one-twentieth of the time of previous tests—and is about three times as precise.

Using a controlled humidity cabinet for testing corrosion, these Standard research men installed a system for cooling metal test panels (previously treated with rust preventive) so that their surface temperatures are lower than the temperature in the cabinet. Temperatures of panel surfaces and of cabinet atmosphere are held accurately. Controlling the temperature of the panels controls the rate at which water condenses on them. This in turn (for the first time) permits accurate control of the amount of condensation on the panels. Rust preventives are more speedily and precisely tested. Science, as a result of this work, has a new tool with which to test corrosion.

This is the research pay-out industry receives from Standard Oil. This is the something extra that backs up the Standard industrial lubrication specialist who calls on you. This is the something extra found in the products he sells.

To know more about how Standard Oil industrial lubrication specialists—and Standard's research program—can help you, call the Standard Oil office nearest you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

## THE MAGIC BOX

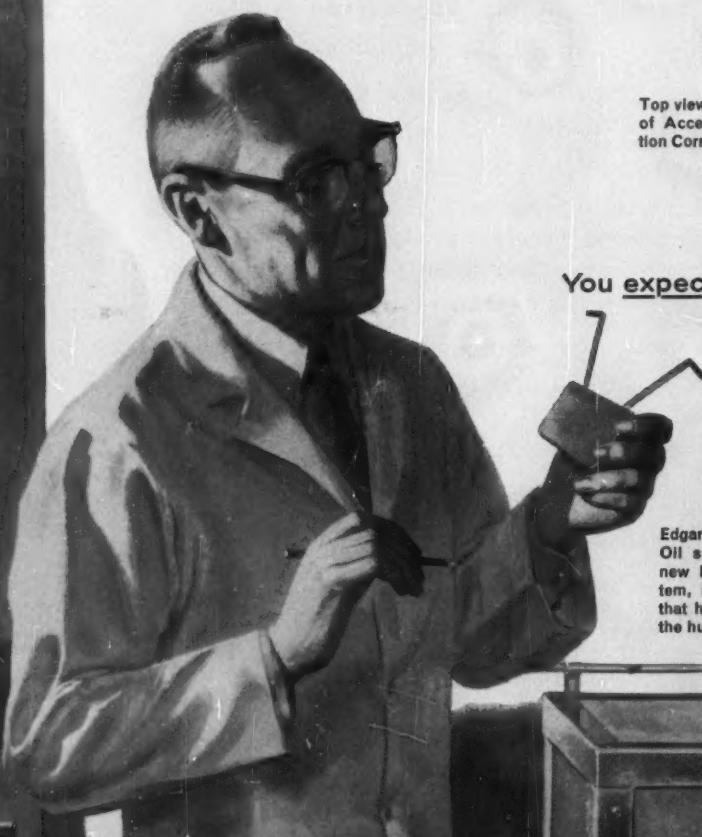


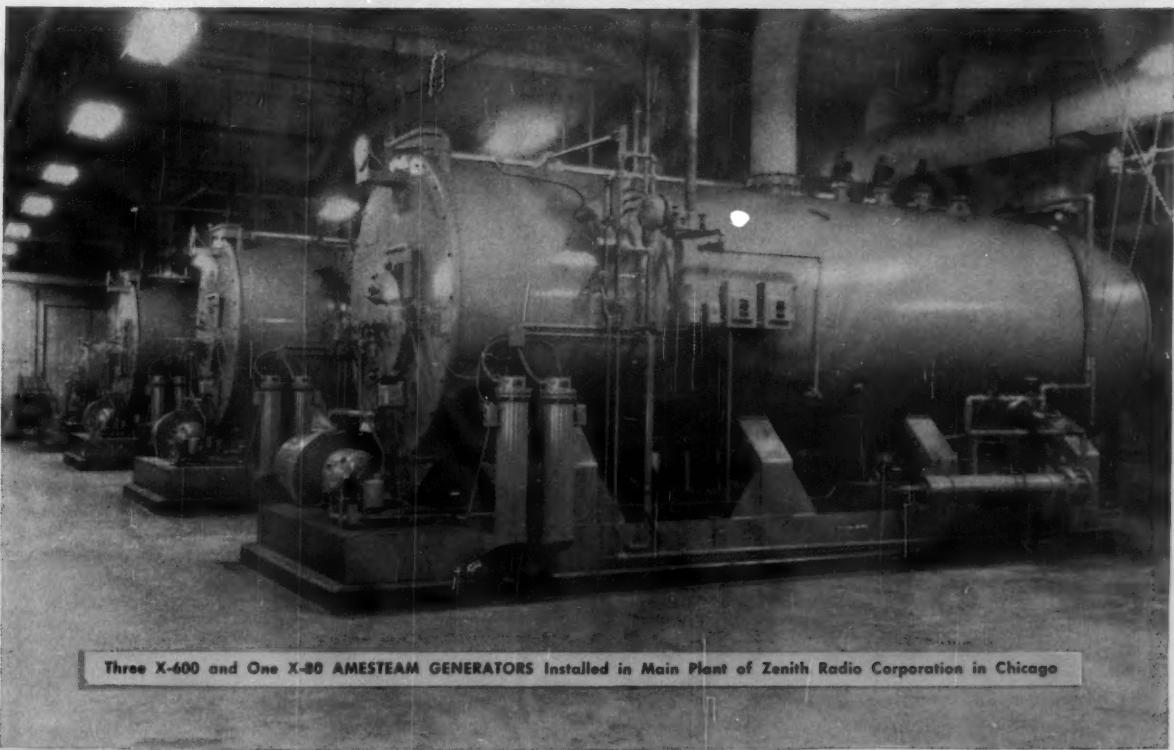
Top view and cross section  
of Accelerated Condensation  
Corrosion Test cabinet.

You expect more from **STANDARD** and get it!



Edgar A. Dieman, Standard  
Oil scientist, Inventor of  
new Rust Preventive System,  
inspects metal panel  
that has undergone test in  
the humidity cabinet.





# AMESTEAM GENERATOR PERFORMANCE

## BRINGS REPEAT ORDERS FROM ZENITH RADIO

"We wish to advise you of our satisfaction with the four AMESTEAM GENERATORS installed in our main plant in Chicago."

So writes Mr. G. R. Price, Superintendent of Maintenance, Zenith Radio Corporation.

"These Ames boilers are in their third full season of operation, and we are very pleased with their performance. They have proven remarkably free from operating trouble, and we rely on their automatic operation without maintaining an engineer on duty.

"Combustion efficiency is excellent, and we are able to operate these AMESTEAM units through the

entire heating season without opening rear baffle or cleaning tubes until the summer check-up.

"To indicate our satisfaction with your equipment, we have installed a 300 HP AMESTEAM unit and two 125 HP AMESTEAM units in other locations, since the original installation in the main plant."

This, along with hundreds of other letters in our files, proves that AMESTEAM GENERATOR customers are *repeat* customers. Why is this so consistently true? Because AMESTEAM GENERATOR Automatic "Package" Boilers are recognized throughout industry for their ability to deliver *low-cost steam*, efficiently, dependably, over a long period of years.

### WHAT'S YOUR STEAM PROBLEM?

If you need 10 to 600 HP and want the kind of space-saving, trouble-free service enjoyed by satisfied owners of AMESTEAM GENERATORS, write today for our catalog and the name of your nearby AMESTEAM Dealer.

**AMES IRON WORKS INC.**  
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**R&IE****LOW VOLTAGE BUS**

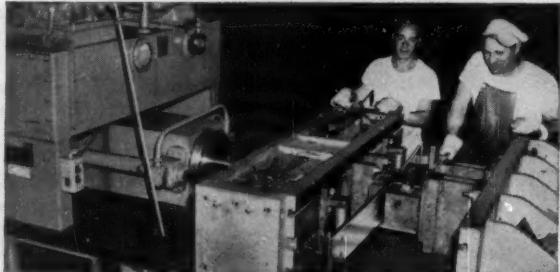
Overhead view of 45,000 amp a-c bus feeding bank of graphitizing furnaces at Stackpole Carbon Company. Bus is interleaved to reduce reactance drop. Insulation is Transite.

## FIRST-CLASS AVENUES FOR YOUR AMPERES

R&IE's broad experience in low voltage bus design and fabrication—for electrochemical and electrothermal processes—means high current distribution systems that are easier to install, longer lasting, and trouble-free. And, by supplying a fully detailed set of assembly and installation drawings with each system, R&IE assures simpler, lower-cost future expansion.



**Experienced R&IE bus design engineers** are available to join in your early planning. Their knowledge can help reduce costs . . . improve system performance. They will determine the most suitable materials, protective finishes, bus size and configuration. Later they will provide sound solutions to design problems such as bus support spacing for maximum short circuit protection, provision for structural misalignment, and proper application of disconnecting switches.

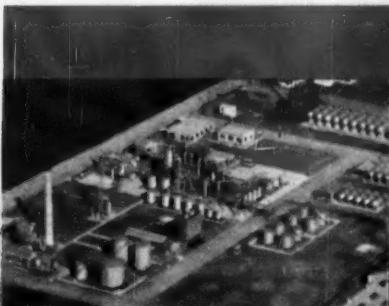


**Skilled workmen, using specialized machinery**, produce bus components accurately and efficiently, assuring low production costs and fast, trial-and-error-free installation. R&IE shop personnel are thoroughly familiar with the fabrication of aluminum and copper. And they have at their disposal a full range of specially adapted tools and machinery for highly accurate cutting, punching, forming, welding and assembling bus, disconnecting switches and flexible bus connectors.

For complete information about R&IE's low voltage bus design and fabrication service, write for Bulletin 1220C, or contact your nearby I-T-E sales office. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.



**I-T-E CIRCUIT BREAKER COMPANY**  
**R&IE EQUIPMENT DIVISION • GREENSBURG, PA.**



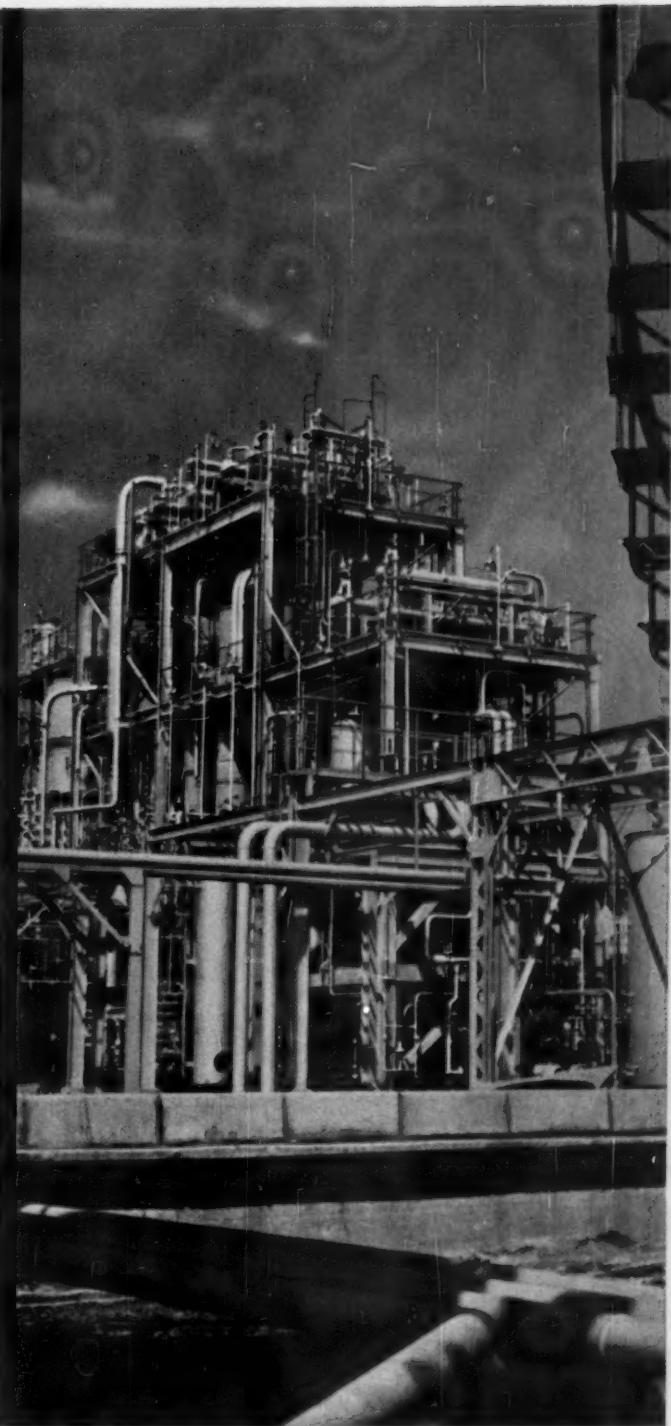
## West to the Orient

### NEW DESIGNS FOR NEW PRODUCTION RECORDS

With local demand running far greater than imported supplies, Nippon Petrochemicals Co., Ltd. called on Stone & Webster to design Japan's first Isopropyl Alcohol and Acetone plant. And within a few days of being placed on stream, this flexible, highly instrumented plant at Kawasaki has produced at a rate above designed capacity and purity. This is Japan's first petrochemical unit to set such a production record from the very start.

Such profitable installations require that production schedules and budgets be met, and possible operational difficulties be solved at the blueprint stage. Through Stone & Webster Engineering Corporation this skilled ability and experience is available for your next engineering project - whatever its type or size or location. Simply call or write our nearest office.

*Stone & Webster adds profits to your project through engineering economies and extra plant efficiency.*



*4.4 million pounds of 99% IPA and 7.7 million pounds of 99.5% acetone per year are produced at this plant designed by Stone & Webster from processes developed by The Distillers Company Limited and British Hydrocarbon Chemicals Limited. Further facilities for ethylene and butadiene production are now being designed by Stone & Webster.*



**STONE & WEBSTER ENGINEERING CORPORATION**

*Affiliated with STONE & WEBSTER ENGINEERING LIMITED (LONDON)*

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in bulk handling...

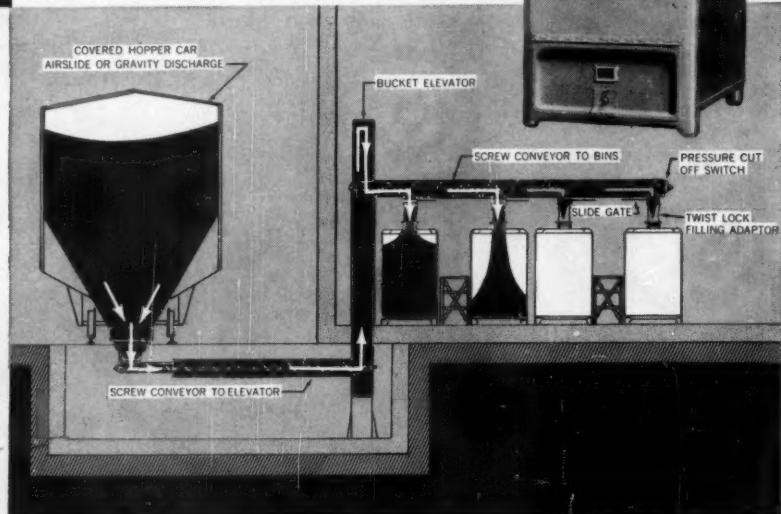
# TOTE SYSTEM

## BULK HOPPER CARS

offers GREATEST  
transportation flexibility

\*

Tote, a *complete, mechanical, automatic bulk handling system*, is based on metal bins (aluminum, stainless or carbon steel, monel, or magnesium) plus filling and discharging equipment. Here is how it fits any transportation situation:



Tote System can be adapted readily to the use of bulk covered hopper cars, gravity discharge or Airslide\*, when these are furnished free by the shipper or by the railroad.

The drawing above shows how quickly and easily mechanical or pneumatic car unloading and Tote filling equipment moves the contents of the car into Tote Bins. The Bins can then be weighed and placed in your warehouse. (Only with Tote

can you weigh your incoming material as a check against your supplier's invoice and also for inventory purposes.)

One man can handle the entire operation — unloading the car, filling, weighing, warehousing the Bins, and moving previously filled Bins from warehouse to discharge stations. In many installations, 100,000 pounds of material are being moved through the complete cycle in less than four hours by one man.

### CONTAINER CARS

This special railroad car carries 26 Bins which can be filled by your supplier while still on the car. At your plant or team track, one man with a fork lift can unload the car in 35 minutes. A mileage allowance of 3.7 cents is paid for every mile this car travels.

If bulk hopper trucks are employed, they can be unloaded into Tote Bins by the same method used to unload rail hopper cars. Or up to 16 Tote Bins, depending on weight restrictions, can be carried on conventional trucks and trailers.

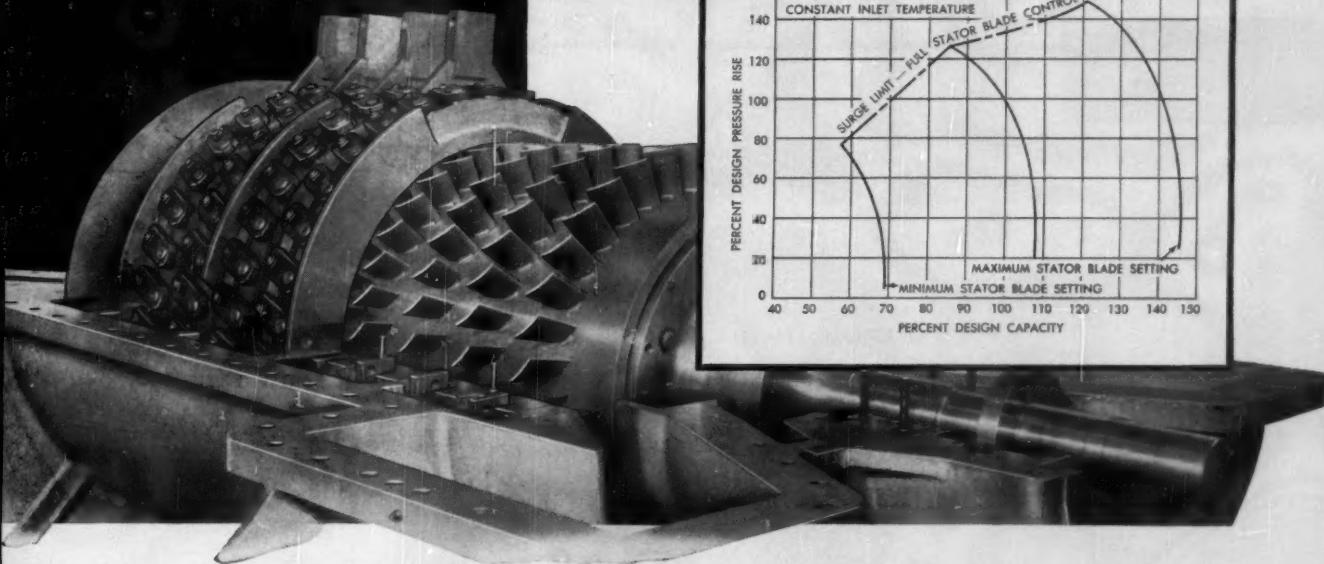
*Why not let our engineers survey your plant at no obligation?  
Meanwhile, write for new catalog containing complete details*

\*Tote and  
Tote System  
Reg. U. S. Pat. Off.

**TOTE SYSTEM, INC.**  
600 SO. 7TH  
BEATRICE, NEBRASKA



# NEW Adjustable Stator Blade Axial Compressors

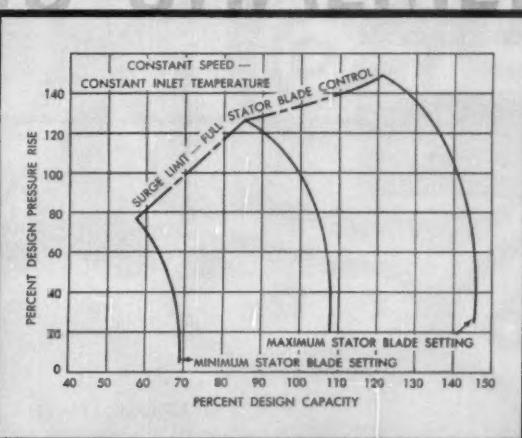


## Get wide capacity range at high efficiency

WITH adjustable stator blade control, now available on Allis-Chalmers axial compressors, varying capacity needs can be met by merely changing stator blade settings — while the machine is in operation. Limited operating range need no longer be a problem.

In fact, Allis-Chalmers axial compressors can now be used with almost the same capacity variation as the centrifugal, while maintaining the axial's characteristic high efficiency and pressure rise at part load points.

For details on the adjustable stator blade axial compressor, call your nearby A-C office, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.



*These additional advantages are inherent in axial compressor performance:*

1. Because of the axial's wide range at constant speed, either steam turbine or motor drive can be used.
2. Small size, light weight of axial units cut space requirements, reduce foundation size and cost.
3. High compressor efficiency reduces horsepower required in driving an axial as much as 12%, compared with other compressor types.

# ALLIS-CHALMERS

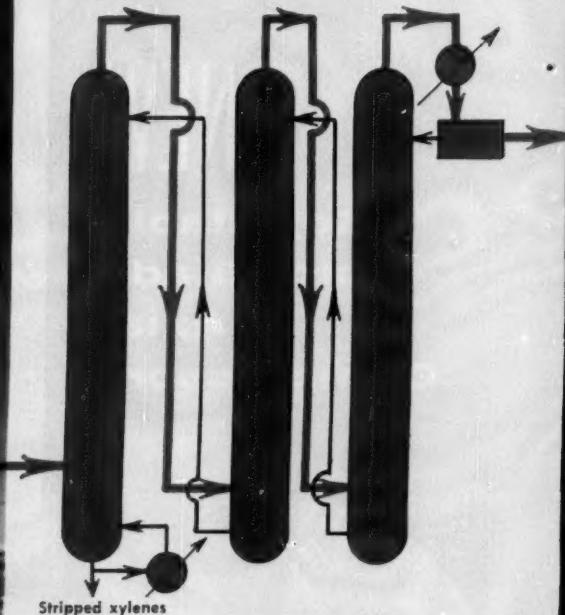
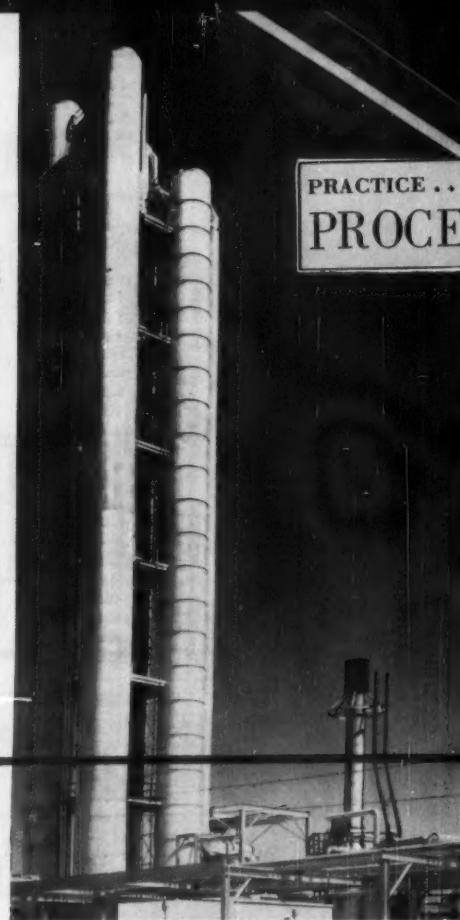
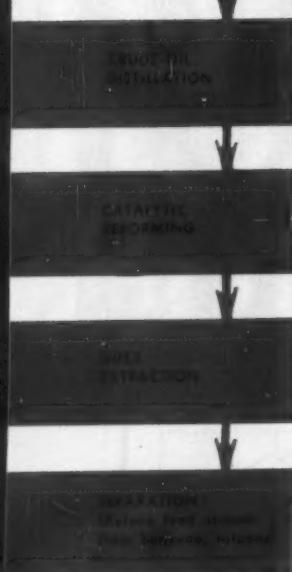


Crude oil

PRACTICE ...

## PROCESS FLOWSHEET

C. H. CHILTON



These three 200-foot-high towers separate ethyl benzene from a narrow-boiling range of mixed-xylenes feed and key integrated process that now wins . . .

## Polystyrene via "Natural" Ethyl Benzene

Cosden Petroleum Corp. recently swung on stream its 22-million-lb./yr. polystyrene unit at Big Spring, Tex., vaulting itself into the fast-moving plastics field and simultaneously scoring two impressive firsts in the petrochemicals field:

- Integrated processing from crude oil to polystyrene at one site.
- Direct recovery of ethyl benzene from narrow-boiling, mixed-xylenes stream. Ethyl benzene is subsequently dehydrogenated to styrene.

Moreover, by aiming for plastics rather than synthetic-rubber markets, Cosden may have forged itself a better market position in the com-

petitive monomer business. Styrene capacity, now about 1.2 billion lb./yr., will exceed demand for a while yet (*Chem. Eng.*, Jan. 27, 1958, pp. 95-96). But polystyrene may well be the most profitable market in years ahead.

Cosden is set up to produce two grades of plastic molding compounds: clear general-purpose and high-impact natural.\*

► **A 600-ft. Wedge** — Most eye-catching accomplishment, both from a physical and engineering point of view, is the monomer unit's ultra-

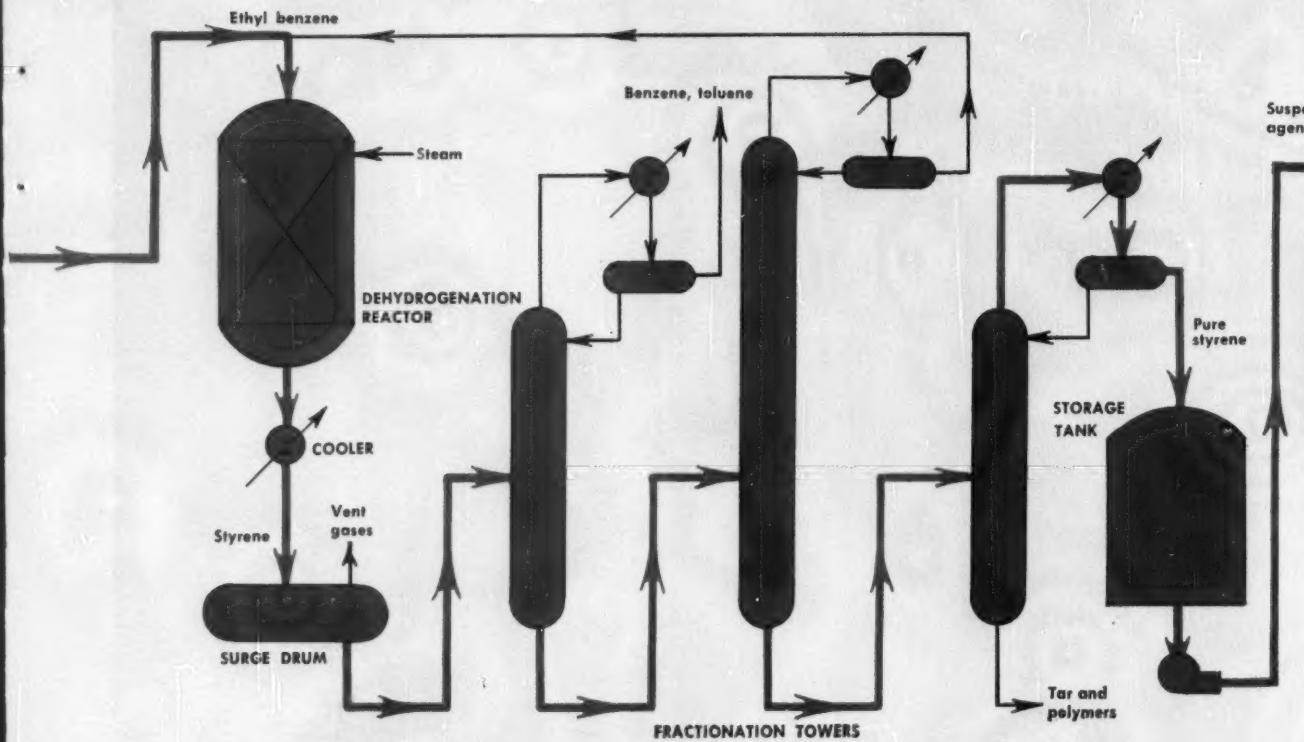
\* High-impact product is generally a styrene-rubber copolymer or mixture, 2-20% rubber, using SBR, nitrile or natural rubber.

fractionation setup with which Cosden pries ethyl benzene directly from a mixed-xylene feed stream. It's this step, in place of the conventional ethylation-of-benzene synthesis, that gives Cosden's ethyl benzene its claim to the "natural" title.

At the front end of the styrene monomer unit, Cosden marshalls a total of 600 ft. of fractionating height, comprising some 350 plates, to drive a wedge between ethyl benzene (b. p., 136.2 C.) and nearest-boiling paraxylene (b. p., 138.5 C.). The 600 ft. of rectifying height are split into three 200-ft. columns and joined laterally by six platform lev-

Unfold Flowsheet →

ON



els with a fourth 185-ft. column, used later in the process.

Monomer unit, designed and constructed by Badger Mfg. Co. working closely with Cosden, has been operating since 1957 (*Chem. Eng.*, June 1957, pp. 160-162).

June 1957, pp. 100-102). **► High-Purity Problems**—Polystyrene plant, engineered and built by Blaw-Knox, Chemical Plants Div., presented several problems because of strict product-contamination requirements. Water, for suspension polymerization and washing, must be extremely high-purity; all water lines are run in aluminum, and all vessels, from reactors through product storage silos, are glass-lined steel.

To solve the problem of dust contamination, all equipment with the exception of water treaters and storage silos are enclosed in air-conditioned, pressurized buildings. ► **A Narrowing Fraction** — Here's how Cosden's process works, essentially narrowing down a fraction of crude oil until it consists only of ethyl benzene, then converting this to styrene and polymerizing.

Crude oil enters a conventional atmospheric-distillation unit which produces a straight-run naphtha (ASTM distillation range: 150-390

F.). After sulfur removal (via Unifining, clay treatment or both), naphtha flows to prefractionator, and then (ASTM distillation: 150-300 F.) feeds to a Platformer. Here, at about 900 F. and 360 psig., naphthenes are converted to aromatics over platinum catalyst.

Aromatic constituents of Plat-formate are glycol extracted in a Udex unit, and are fractionated at atmospheric pressure into benzene, toluene and xylenes. Mixed xylenes, containing 25-30% ethyl benzene, are feed for the styrene monomer unit.

**The Big Split**—Feed enters the first 200-ft. column near its midpoint; bottoms from this column are mixed xylenes. Rectification continues through the next two columns in series, with forward vapor feed and backward pumping of liquid reflux. Cosden has attained 99.7% ethyl benzene purity, but this is not normally needed for styrene manufacture.

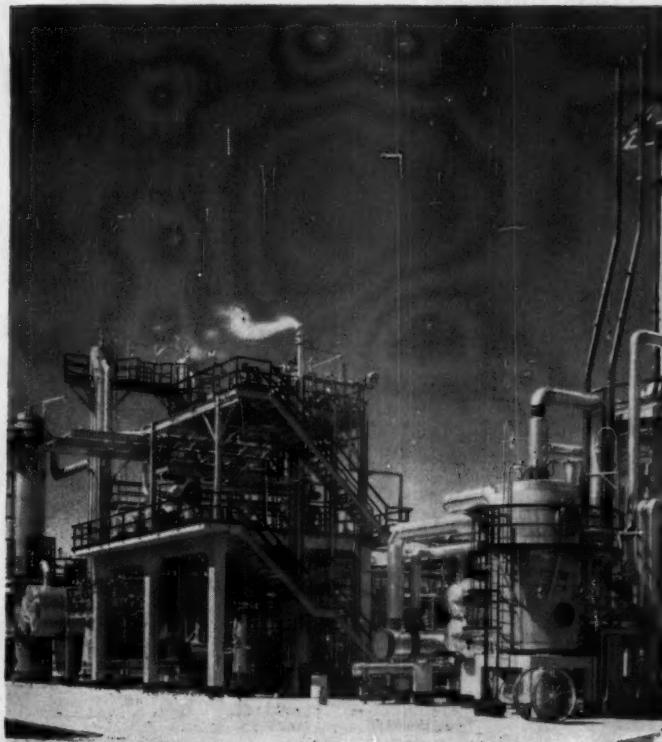
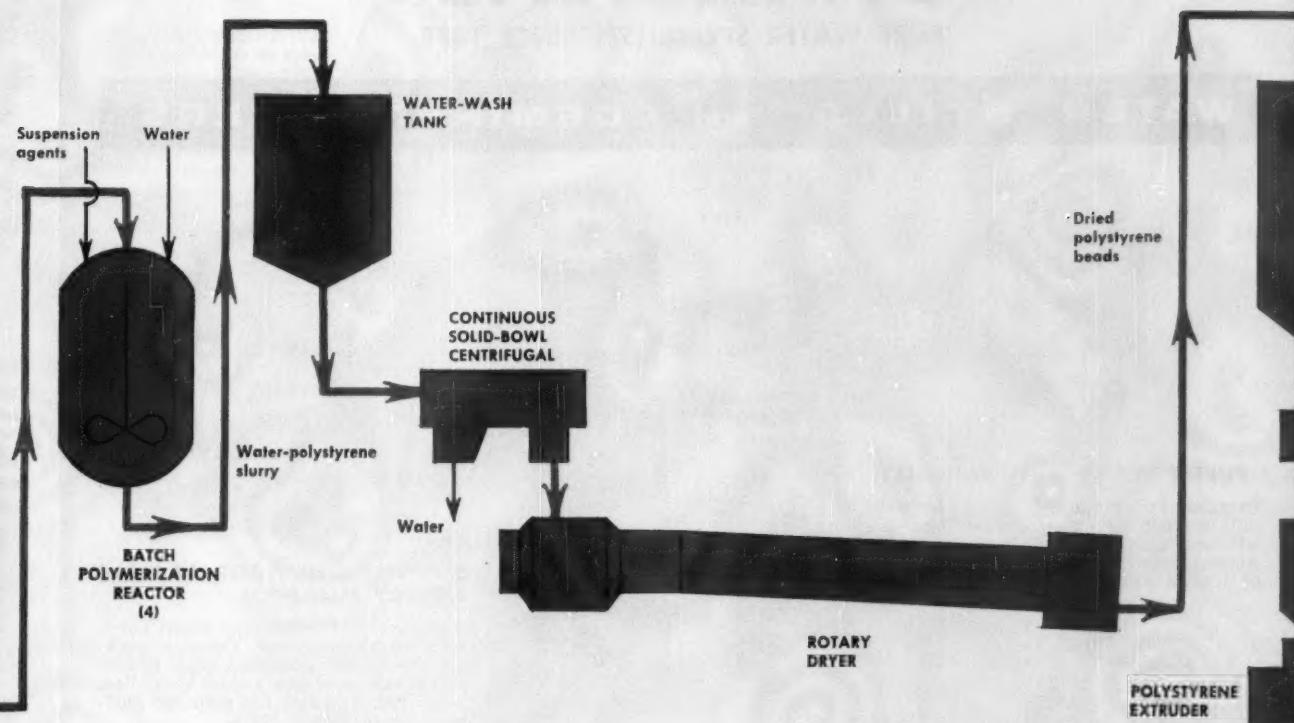
Ethyl benzene is routed to dehydrogenator where it's converted to crude styrene over iron, chromium and potassium oxides. Reactor effluent contains about 40% styrene and the rest is largely ethylbenzene. However, some benzene

and toluene have to be separated in a small fractionating tower, roughly 50 ft. high.

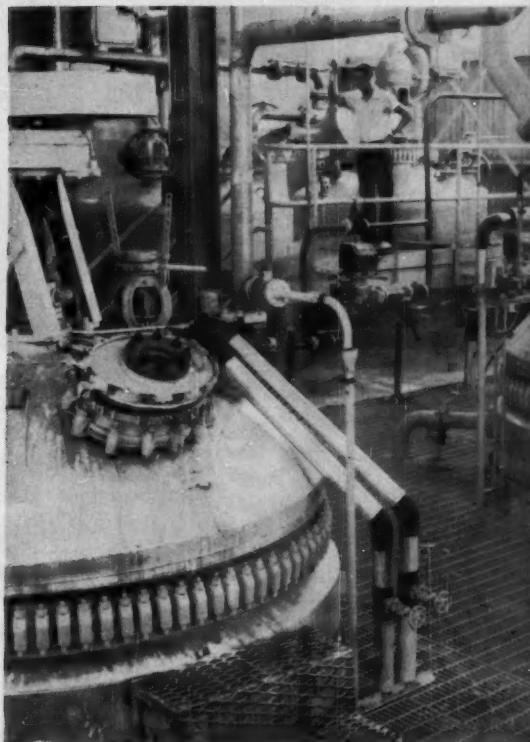
Ethyl benzene recycle is vacuum distilled in a 185-ft. tower, mentioned above, tied in with the three 200-ft. towers. Then high-purity monomer is vacuum distilled from polymer and tars and stored in refrigerated tanks below 60 F. to thwart polymerization.

**Suspension Makes Beads** — Monomer is charged to one of four glass-lined, stirred, batch reactors, along with water and suspension agents. Catalyzed suspension polymerization forms a slurry of solid polystyrene beads in water. After reaction cycle, slurry is water washed and beads are separated in a Bird continuous solid-bowl centrifugal. Beads are dried in a steam-heated rotary dryer and pneumatically transferred to storage for blending and testing. Here, beads are blended to make either high-impact or general-purpose product.

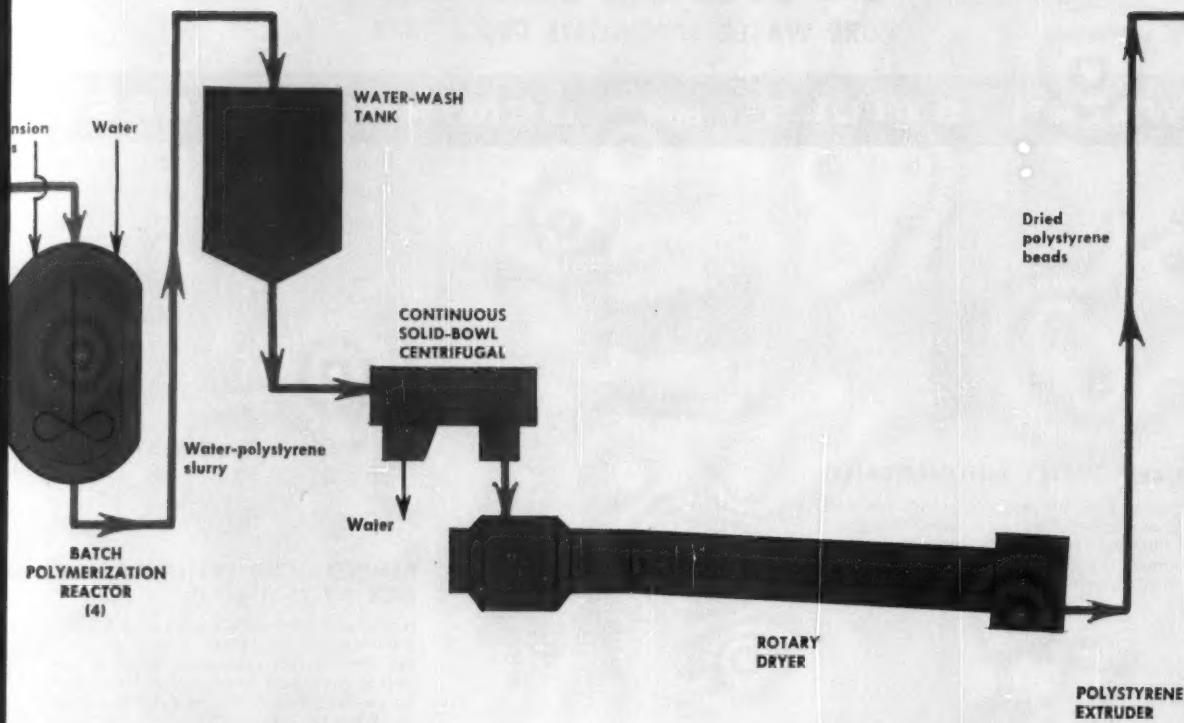
Then polystyrene is extruded, water-cooled, and dried with air jets. Finally, strands are chopped into  $\frac{1}{4}$ -in. pellets and sent by pneumatic conveyor to bins for final quality control and then to bulk-storage silos.



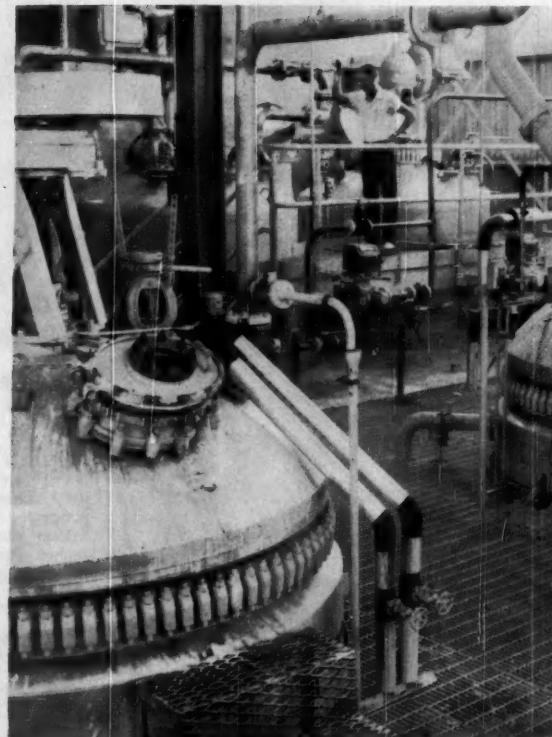
MONOMER-FINISHING AREA contains ethyl benzene dehydrogenation reactor and towers to remove tars and unreacted ethyl benzene.



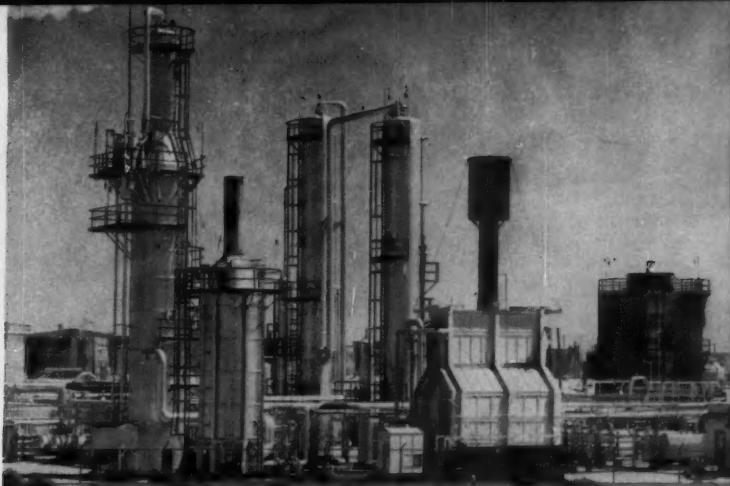
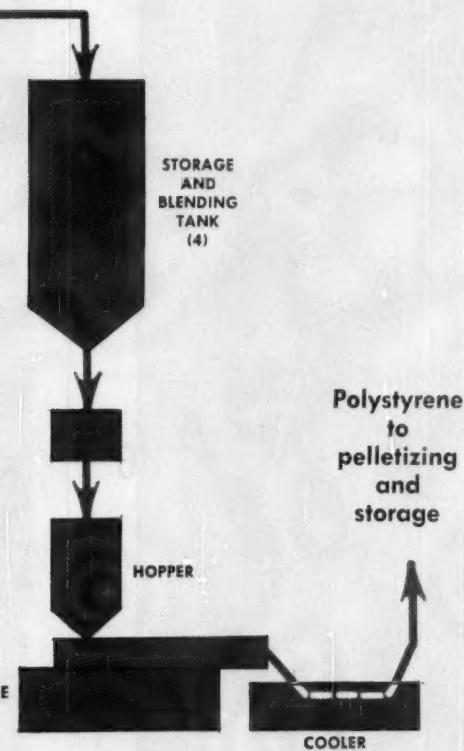
BATCH POLYMERIZATION REACTORS, working in series, convert styrene to polystyrene at a 22-million



MONOMER-FINISHING AREA contains ethyl benzene dehydrogenation reactor and towers to remove tars and unreacted ethyl benzene.



BATCH POLYMERIZATION REACTORS, working in stages, convert styrene to polystyrene at a 22-million-



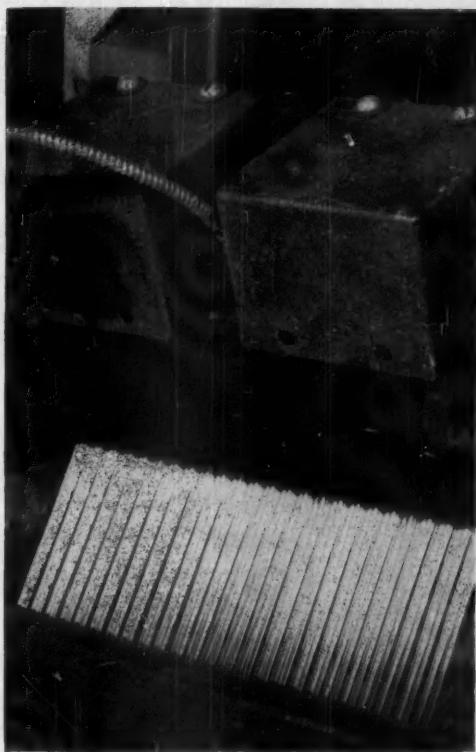
CRUDE UNIT, first process unit, distills straight-run naphtha.



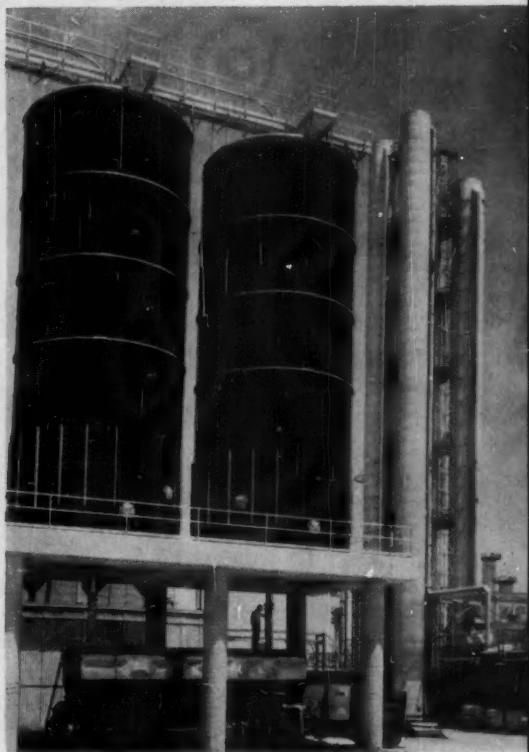
PLATFORMER-UDEX produces aromatics, separates xylene feed.



ing in staggered open 2-million-lb./yr. rate.

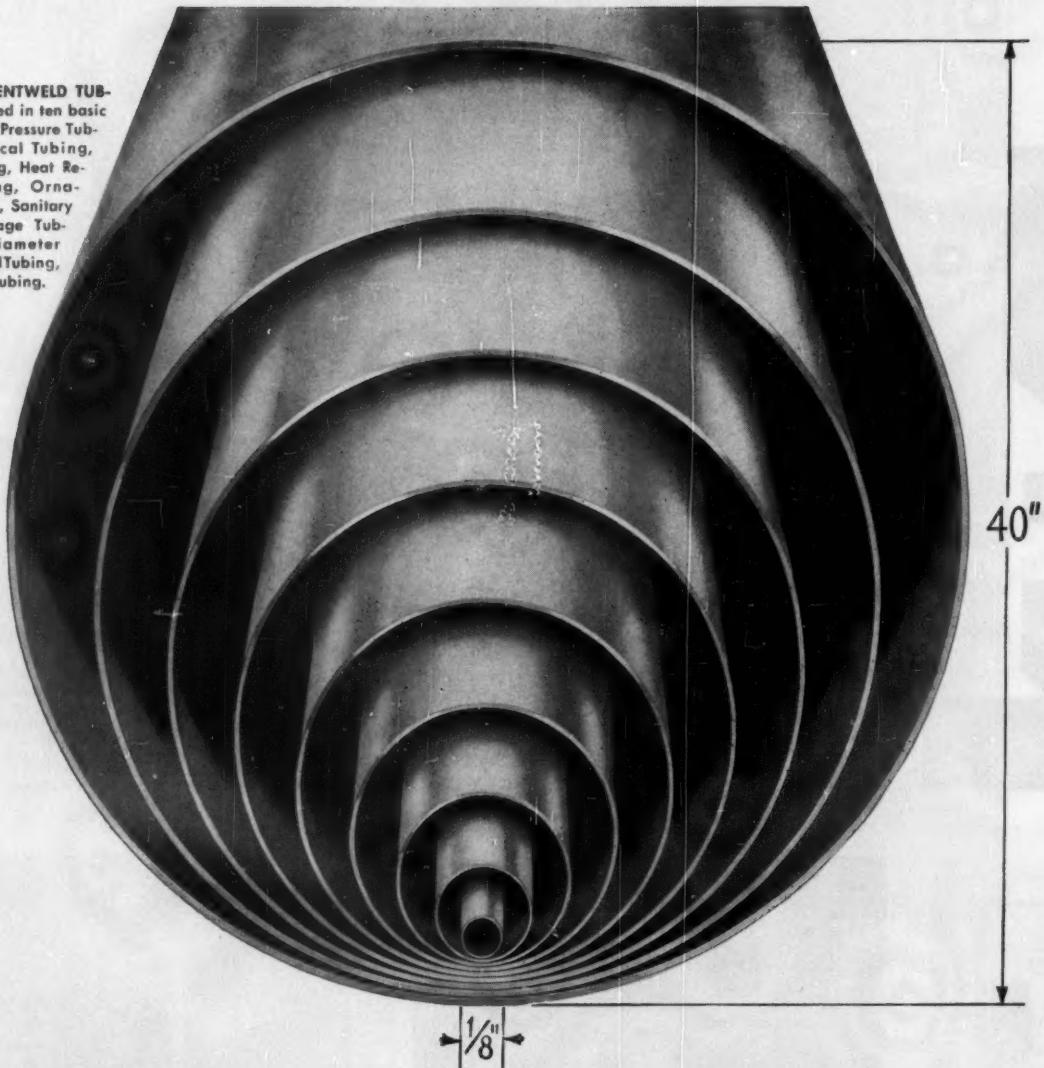


EXTRUDER makes thermoplastic strands from dried beads; the strands are then water-cooled.



STORAGE SILOS load pneumatic trailers which can deliver 30 tons/hr. to customers.

**CONTOUR TRENTWELD TUBING** is furnished in ten basic classifications: Pressure Tubing, Mechanical Tubing, Aircraft Tubing, Heat Resistant Tubing, Ornamental Tubing, Sanitary Tubing, Beverage Tubing, Large Diameter Tubing, Shaped Tubing, and Formed Tubing.



## TRENTWELD tubing is equal in strength and has more uniformity than tubing made by any other method of manufacture

Trent offers tubing in sizes ranging from  $\frac{1}{8}$ " to 40" O.D. and in a wide range of grades. These include: Hastelloy,\* Zirconium, Zircaloy, Titanium and 19-9-DL grades. All are made by an exclusive welding process—Contour Trentweld®—which virtually eliminates the bead. Furthermore, by cold working and annealing after welding, Trent makes the weld equal in strength and corrosion resistance to the parent metal.

- To insure that Trentweld tubing

is of the highest quality attainable, a rigorous quality control program is carried out. Samples of each lot are tensile tested. Periodic tests—flattening, reverse bend, flare and flange, coil, and pressure—are conducted. Rigid corrosion tests are made on all lots intended for corrosive applications. When requested, a unique "single-wall" X-ray inspection is made as your final assurance of a sound, uniform product.

Why not take advantage of Trent

quality when you order stainless or high alloy tubing? For further information, write for the Trent tubing handbook, Trent Tube Company, East Troy, Wisconsin.

\*Trademark of Haynes, Stellite Co.

**CONTOUR  
TRENTWELD**

**TRENT  
TUBE  
COMPANY**

Subsidiary of Crucible Steel Company of America  
GENERAL OFFICES: EAST TROY, WISCONSIN  
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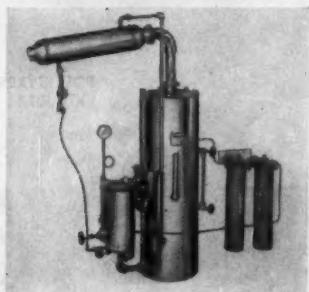
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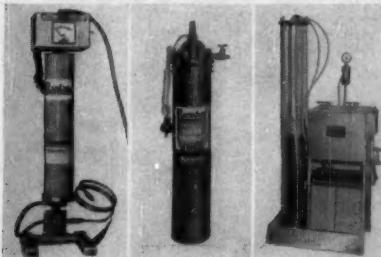
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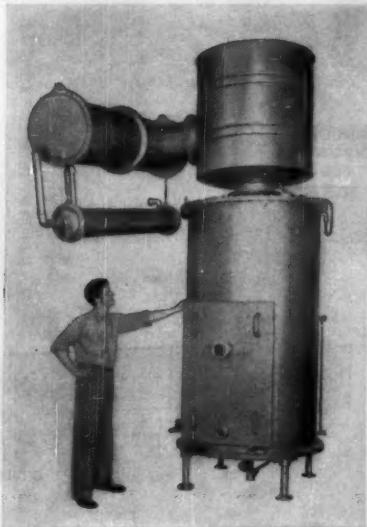
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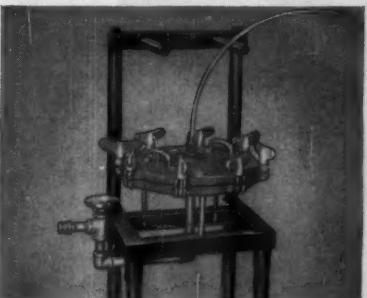
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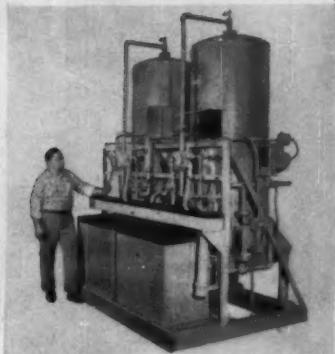


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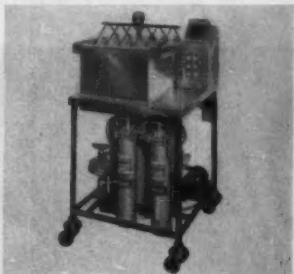
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# *Chemical Engineering*

## Practice

### **Ultrafractionation keys modern polystyrene process . . . 98**

The new look in polystyrene manufacture is Cosden Petroleum's integrated plant at Big Spring, Tex. Tricky fractionation step separates ethyl benzene from mixed xylenes.

### **How to design flow systems for full-range control . . . . 107**

To assure adequate design of any flow system, consider the mutual effects of control valve pressure drop, system dynamic losses and centrifugal pump head.

### **Charts convert cooling tower data to other conditions . . . 111**

If you have just one set of performance data on your cooling tower you can: (1) find if it's doing its design job, (2) find what it will do under other conditions.

### **Speed water-on-shellside heat exchanger design . . . . 117**

Here's another aid to calculation of heat transfer coefficients and pressure drops. Charts apply to water flow on the shellside of tubular exchangers.

### **How to estimate stage efficiency in mass transfer . . . . 119**

You can use these methods to calculate over-all, plate and point efficiencies in bubble-cap and sieve-plate columns for distillation and absorption.

### **CE cost file shows more heat exchanger cost curves . . . 123**

In this issue we present costs of floating head exchangers of the split ring and removable bundle types. Curves offer costs in concise, usable and very fileable form.

### **Will the new rules entitle you to overtime pay? . . . . 127**

Suggested revisions of the federal wage-hour regulations defining professional employees are now being considered. If approved, they may put more money in your pocket.

### **Tough, strong nylon 6 bids for process applications . . . 130**

This latest form of nylon, stronger and more resistant than the usual nylons, will soon be available as pipe and fittings for corrosive process applications.

**DEC. 1, 1958**

#### **Department Index**

Process Flowsheet . . . . .	98
Feature Articles . . . . .	107
CE Refresher . . . . .	119
CE Cost File . . . . .	123
Plant Notebook . . . . .	125
You & Your Job . . . . .	127
Corrosion Forum . . . . .	130

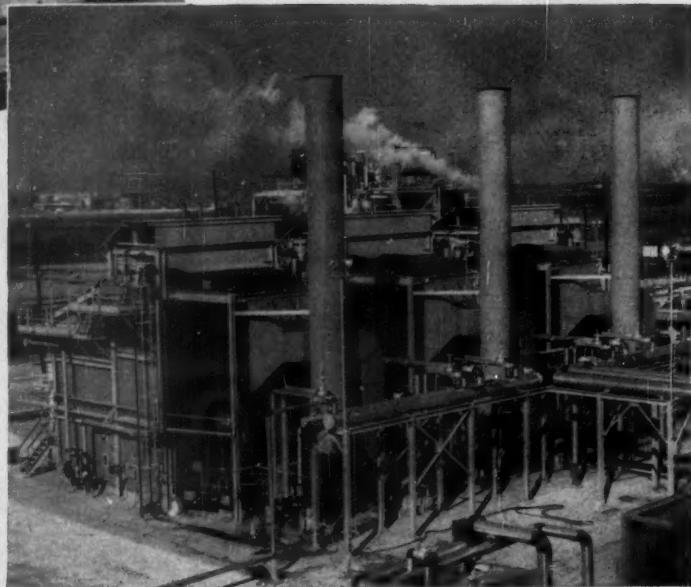
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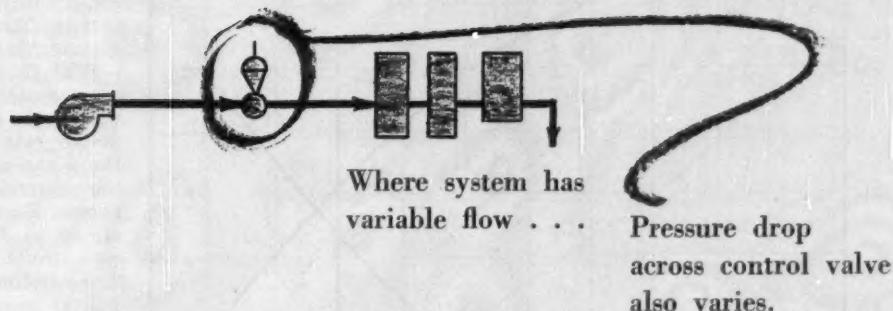
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By Proper System Design . . .

## Assure Full Range Flow Control

In design calculations, include joint effect of control valve pressure drop, system friction loss and pump discharge pressure.

JOSEPH CONISON, The Ralph M. Parsons Co., Los Angeles, Calif.

A standard procedure for determining the required design pressure drop across a control valve located on the discharge side of a centrifugal pump was urgently needed in our organization. This procedure was to be used by the engineers in our Mechanical Engineering section who specify the pumps but who are not too familiar with the requirements of control valve pressure drops.

As a rule, the pumps have to be requisitioned early in the job schedule. Any revision to pump head requirements is very costly when made late in the job schedule by the instrument engineer. This revision may arise if the pressure drop provided for the control valve in the pump head characteristics is not sufficient.

Before proceeding with the standard, we agreed to conform to the general thinking in the process industry and be guided accordingly. An investigation of available standard operating procedures among engineering and operating companies revealed that only a very few have developed them. One company's standard would not be accepted by another because of divergent requirements.

Having no common basis with which to start, we decided to develop our own standard based on sound engineering principles. We were also guided by practical and economic principles. In developing the standard, our objective was to make it acceptable

to our clients who did not have their own standards.

As a starting point, we definitely decided to avoid the pitfalls of the system shown in Fig. 1. This system has no additional capacity above the normal design flow and furthermore is definitely weak on control.

Our ultimate aim was to pattern our approach after the system shown in Fig. 2 which has:

- A contingency for additional flow rate.
- Sufficient control valve pressure drop for the additional capacity.

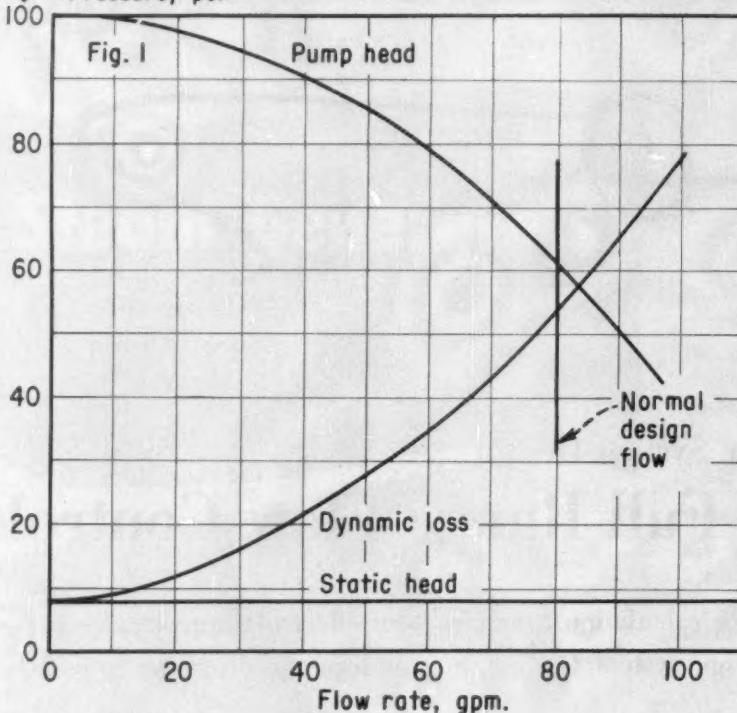
### Provide Adequate Pump Capacity

The first point to firm up is the maximum pump capacity. A check with the design capacity of other equipment reveals that, in general, they are designed to process a maximum of 10% over the normal design. The only exceptions are reflux pumps and occasionally water pumps. Reflux pumps have as much as a 25% increase over the normal design rates. This is understandable since the service is subject to changes in feed composition, ambient temperatures and cooling water temperatures.

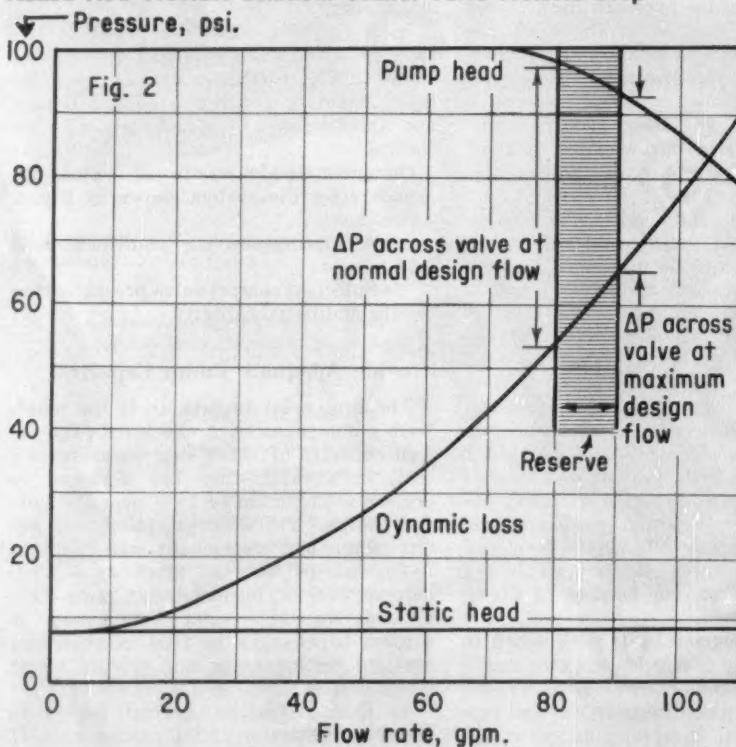
In this discussion, normal design is based on the design of the process unit. If unit is designed to process 10,000 bpd.,

## FLOW CONTROL . . .

### No Reserve Above Normal Design Flow Gives Weak System Control



### Added Flow Provides Sufficient Control Valve Pressure Drop



then the design capacity of each item is based on the ability to process its share of incoming feed of 10,000 bpd. to the unit.

Maximum design referring to equipment is the rated capacity of that equipment and is generally greater than normal design.

With the knowledge of the maximum design of the equipment, it was agreed to establish a maximum design rate for the pumps at 1.1 times the normal design rate for the equipment associated with the pumps. Exceptions to the 1.1 factor are to be dealt with as the occasion arises. In this manner, all "over-designs" of the equipment will at least match with one another. After firming up the pump capacities, the next step is to determine the minimum valve capacities.

### Control Valve Capacity

A check with various control valve manufacturers indicates that good control may be obtained with control valves up to a maximum of 95% of rated capacity. In other words, if a control valve is rated at 100 gpm. at 10 psi. pressure drop, then the control valve can increase or decrease the flow at 95 gpm. at the specified pressure drop. At 100 gpm., the control valve can decrease the flow but not increase it. In the latter case, good control is beyond the limit of the control valve. Hence, the system is said to have "run out of control."

With the vendors' guarantee of good control at 95% of the valve maximum flow rates, it was decided to rate the control valve on a minimum flow of 5% over the maximum design capacity of the centrifugal pump.

The following example shows how to determine the various design rates.

- Normal design rate through a process unit as established by the process engineer is 100 gpm.

- Pump maximum design rate or rated pump capacity equals  $100 \times 1.1$  which is 110 gpm.

- Control valve located on the discharge side of the pump will be sized at a minimum rate of 1.05 times pump maximum design rate. For this problem, minimum rate equals  $1.05 \times 110$  which is approximately 116 gpm. The valve may be sized for a capacity greater than 116 gpm. but not less.

The present method of establish-

ing a control valve pressure drop on the discharge side of a centrifugal pump is very inconsistent. No two engineers, clients or control valve manufacturers agree on a usable method to determine pressure drop; nor do they substantiate their data. Under these circumstances, how can we establish a pressure drop in our standard based on available recommendations that are inconsistent?

Recalling an old statement, "If you know your fundamentals, people will listen to you," we decided to revert to the basic fundamentals. Our approach was to develop our own valve characteristic curves to determine the minimum usable pressure drops for control valves.

Control valve characteristic curves are readily available for constant pressure drop across the valve or where the system pressure drop is 100% across the control valve. A typical valve characteristic curve giving percent valve stem lift vs. percent valve capacity is shown in Fig. 3 for constant  $\Delta P$ . If the control valve is in series with process units such as exchangers, heaters and columns, then the curve at constant  $\Delta P$  does not apply.

From the characteristic curve of a control valve at constant pressure drop, we develop the characteristic curves for the same control valve when subjected to variable pressure drops.

### Flow Controls Pressure Drop

The analysis to determine the characteristic curve for any control valve follows. For simplicity in calculations, a constant pump discharge pressure is assumed. Under this assumption, as flow decreases, the line friction pressure drop decreases and the  $\Delta P$  across the control valve increases. In this discussion, line friction or dynamic loss refers to fluid friction such as in the line, exchangers, heaters but not to static losses or control valve pressure drop.

Let  $R_p$  equal pressure ratio of minimum valve pressure drop  $(\Delta P_v)_{min}$  to maximum system dynamic pressure drop  $(\Delta P_v)_{max}$ . Also let  $R_s$  equal ratio of actual system flow to maximum system flow.

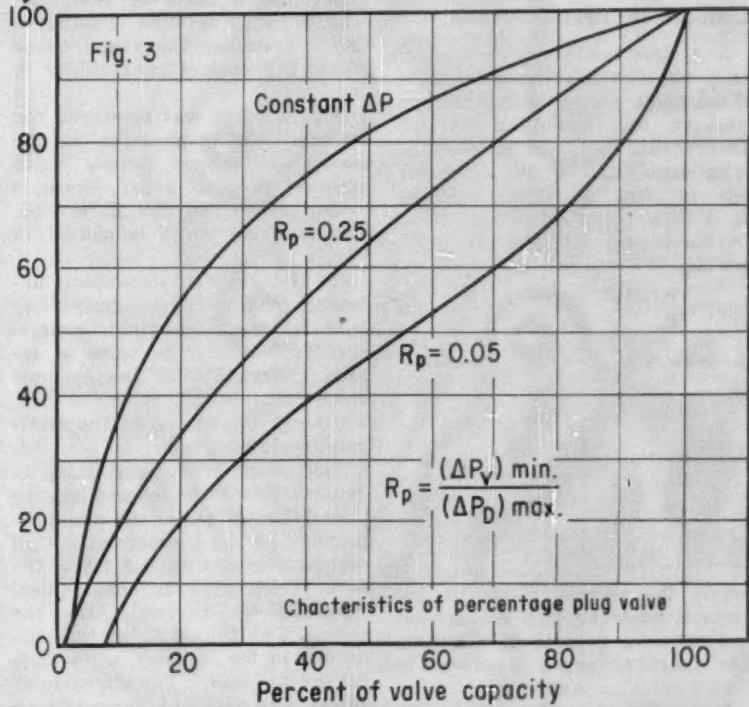
$$R_p = \frac{(\Delta P_v)_{min}}{(\Delta P_v)_{max}} \quad (1)$$

$$R_s = F_v / (F_v)_{max} \quad (2)$$

where  $F_v$  is actual system flow at

### Variable Valve Pressure Drop Changes Characteristic Curve

Percent of valve lift



$\Delta P_v$  and  $(F_v)_{max}$  is maximum system flow at  $(\Delta P_v)_{max}$ .

However, system flow varies as the square root of system pressure drop. Hence, we can write

$$\frac{(\Delta P_v)}{(\Delta P_v)_{max}} = \frac{[F_v / (F_v)_{max}]^2}{(R_s)^2} \quad (3)$$

For a given system where pump head is independent of flow, the sum of system pressure drop and control valve pressure drop is constant regardless of flow rate. Then  $\Delta P_v + \Delta P_D = (\Delta P_v)_{min} + (\Delta P_D)_{max}$ , or

$$\frac{\Delta P_v}{(\Delta P_v)_{max}} + \frac{\Delta P_D}{(\Delta P_D)_{max}} = \frac{(\Delta P_v)_{min}}{(\Delta P_D)_{max}} + 1$$

Substituting Eqs. (1) and (3) in the preceding equation yields

$$\Delta P_v = (\Delta P_v)_{max} [1 + R_p - R_s^2] \quad (4)$$

However, we must find  $(F_v / F_s)$  the ratio of the actual system flow rate to the maximum valve flow rate. The flow rates are taken at corresponding pressure drops such that the sum of  $\Delta P_v$  and  $\Delta P_D$  is constant. From this ratio of flow rates, a percent valve lift may be read from a valve characteristic curve for constant  $\Delta P$  as shown in Fig.

3. The resulting percent valve lift value is replotted against  $F_v / (F_v)_{max}$  which is the ratio of actual system flow to maximum flow for varying control valve pressure drop.

Let  $F_v$  equal maximum valve flow rate at  $\Delta P_v$  and  $(F_v)_{min}$  equal minimum valve flow rate at  $(\Delta P_v)_{min}$ . But, the minimum valve flow rate must equal the maximum system flow rate. Hence,

$$(F_v)_{max} = (F_v)_{min} \quad (5)$$

Since valve flow rate varies directly as the square root of valve pressure drop and Eq. (5) applies, we get

$$\Delta P_v = (\Delta P_v)_{min} \left[ \frac{F_v}{(F_v)_{max}} \right]^2 \quad (6)$$

To find the ratio of  $F_v / F_s$ , we equate Eqs. (4) and (6).

$$(\Delta P_v)_{min} \left[ \frac{F_v}{(F_v)_{max}} \right]^2 = (\Delta P_D)_{max} [1 + R_p - R_s^2] \quad (7)$$

Substitute for  $(F_v)_{max}$ ,  $F_v / F_s$ , from Eq. (2) and for  $(\Delta P_v)_{min} / (\Delta P_D)_{max}$ ,  $R_p$ , from Eq. (1).

Rearranging and collecting terms yields the ratio  $F_v / F_s$ :

$$\frac{F_1}{F_v} = \left[ \frac{R_v^2 R_p}{1 + R_p - R_v^2} \right]^{1/2} \quad (8)$$

### Example Illustrates Method

A system containing a control valve has dynamic losses equal to 40 psi. and a control valve minimum pressure drop equal to 10 psi. Assume that discharge pressure of pump equals  $\Delta P_p + \Delta P_v$  which for this problem is 50 psi. Hence  $R_p = 10/40 = 0.25$ . Use Eq. (8) to find the ratio  $F_1/F_v$ . For this problem Eq. (8) reduces to

$$\frac{F_1}{F_v} = \left[ \frac{0.25 R_v^2}{1.25 - R_v^2} \right]^{1/2}$$

Flow in line, %, or 100 $R_v$	$F_1/F_v$	Percent Valve Lift*
100	1	100
90	0.676	90
80	0.512	83
60	0.318	69
40	0.190	56
20	0.091	37
10	0.045	20

\*Read from valve characteristic curve at constant  $\Delta P$  (Fig. 3) values of % valve lift at  $F_1/F_v$  values.

Replot the percent valve lift for variable pressure drop across control valve vs. percent flow in line. The resulting curve is shown in Fig. 3 as  $R_v = 0.25$ .

To obtain the minimum usable pressure drop across a specific



JOSEPH CONISON has been head instrument engineer since 1957 of the Instrument Engineering Section of The Ralph M. Parsons Co. of Los Angeles, Calif. Previously, he worked for 10 years as project, process and instrument engineer with the Fluor Corp.

He received his B.S. in Chem. Eng. from the University of Cincinnati and is an honorary member of Mu Pi Kappa. He is chairman of the Southern California Meter Association. He is a member of the executive committee of the Instruments and Regulators Div. of ASME and is also a member of ISA.

valve, continuously decrease the pressure drop across the control valve until a curve of reversible characteristics develops. This curve then determines the range below which full control rangeability is unreliable.

Such a curve was developed for the preceding example for the following conditions: control valve pressure drop is 2 psi., dynamic losses are 40 psi. and  $R_p$  is 0.05. The resulting curve is plotted in Fig. 3.

On the basis of developing numerous characteristic curves, we agreed to limit the minimum pressure drop across the valve to approximately 15% of the dynamic losses in the system or 10 psi., whichever is greater, at the maximum design capacity.

The value of 15% pertaining to dynamic losses was selected because it is definitely above the minimum pressure drop for obtaining full control rangeability and below the 25% which exhibits almost ideal characteristic curves. Also the selection of the 15%, in the vernacular of the industry, is "not too fat nor too lean." The alternate of 10 psi. was selected because of past experience where a valve of less than 10 psi. pressure drop invariably results in a control valve larger than line size. Under the most adverse conditions, the size of the control valve is limited to a maximum of line size.

### How to Extend Friction Losses

As mentioned previously, the rates and the dynamic losses at the normal design basis are used by the mechanical engineering section to develop the required pump head for maximum design flow and for the pressure drop across the control valves. If this procedure of selecting the proper control valve losses could be done automatically, then the processing of a project through the organization can be simplified a great deal.

The next step was to provide a method for the mechanical engineers to

- Extend the normal design friction losses to the maximum design losses.

- Calculate the control valve pressure drop from maximum design losses. This method turns out to be very simple. In general, flow rate in the system varies directly

as the square root of the dynamic pressure drop. Mathematically,  $F = \phi'(\Delta P_p)^{1/2}$  or  $\Delta P_p = \phi(F)^2$ . At normal design flow and maximum design flow, we may write respectively:

$$\Delta P_{ND} = \phi(F_{ND})^2 \quad (9)$$

$$\Delta P_{MD} = \phi(F_{MD})^2 \quad (10)$$

To find the maximum design friction losses  $\Delta P_{MD}$ , we extend the normal design friction losses  $\Delta P_{ND}$  by dividing Eq. (10) by Eq. (9). Hence,

$$\Delta P_{MD} = \Delta P_{ND} \left[ \frac{F_{MD}}{F_{ND}} \right]^2 \quad (11)$$

where  $F_{MD}$  and  $F_{ND}$  represent maximum and normal design flow rates.

As an example, if the normal design is 90% of the maximum design, find the friction losses at the maximum design from the data based on normal design. Substituting in Eq. (11), the ratio of flow rates ( $F_{MD}/F_{ND}$ ) equal to 1/0.90, we get  $\Delta P_{MD} = (1/0.90)^2 \Delta P_{ND}$ . Hence, friction loss at maximum design flow rate equals 1.23 times the losses at normal design rate.

On the basis of the method outlined in this article, we can now engineer our pumps and control valves located on the pump discharge to ally themselves with the over-all plant design. This is accomplished by including in the pump head

- A capacity equal to a minimum of 1.1 times the normal design rate for general services and higher for special cases.

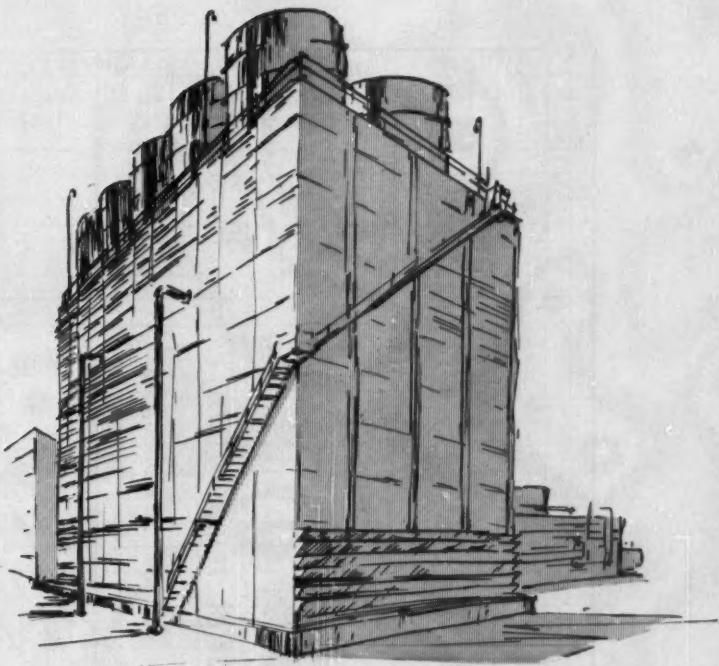
- Sufficient differential head to compensate for the maximum design rate established on the basis of 1.1 times normal design rate.

- Control valve pressure drop equal to a minimum of 15% of the dynamic losses at maximum design flow or 10 psi., whichever is greater.

Application of this system provides (1) an economical initial cost, (2) an efficient plant operation, (3) an insurance of over-all plant capacity extension, (4) a good process control system and (5) an expedient simplified procedure that expedites the processing of a project through the engineering phases.

I wish to take this opportunity to thank the management of The Ralph M. Parsons Co. for permission to publish this article and the members of the engineering sections and control valve manufacturers' representatives for their constructive comments.

Four charts quickly convert one set of performance data to any other set of conditions.



## Checkup on Cooling Tower Operation

EUGENE L. BASS and NATHANIEL P. GREEN, N. P. Green & Associates, St. Louis 23, Mo.

Cooling tower users always have a great deal of difficulty in determining whether equipment they have purchased actually meets the performance conditions which have been specified. The difficulty lies in the fact that in operation the tower is seldom, if ever, called upon to meet the exact conditions specified. However, all cooling towers should be tested. But with the calculation methods available in the past, it has been difficult to compare the results of a test with the performance that would be obtained under design conditions.

By the same token, it has been difficult for users to determine what effect various changes in operating conditions will have on the performance of their cooling towers. It is to make such calculations easy that the performance conversion charts which accompany this article (see next two pages) have been developed. Knowing a tower's performance under any one set of condi-

tions, the charts easily permit the performance to be predetermined under any other set of conditions.

Usual design specifications for a cooling tower require, for example, that the tower be able to cool say 10,000 gpm. of water from 105 F. to 85 F. when the wet bulb temperature of the air entering the tower is 78 F. However, it is unlikely that the exact conditions for which the tower was purchased will ever occur. This is because of the complexity involved in calculating heat loads and frictional resistance in water circuits and because the heat loads and wet bulbs met in practice necessarily will vary.

In the case in the preceding paragraph, a test might show that the tower actually cools 9,000 gpm. of water from 103 F. to 84 F. when the wet bulb temperature is 76 F. Having only these data most purchasers would be at a loss to know whether the design performance could ever be met.

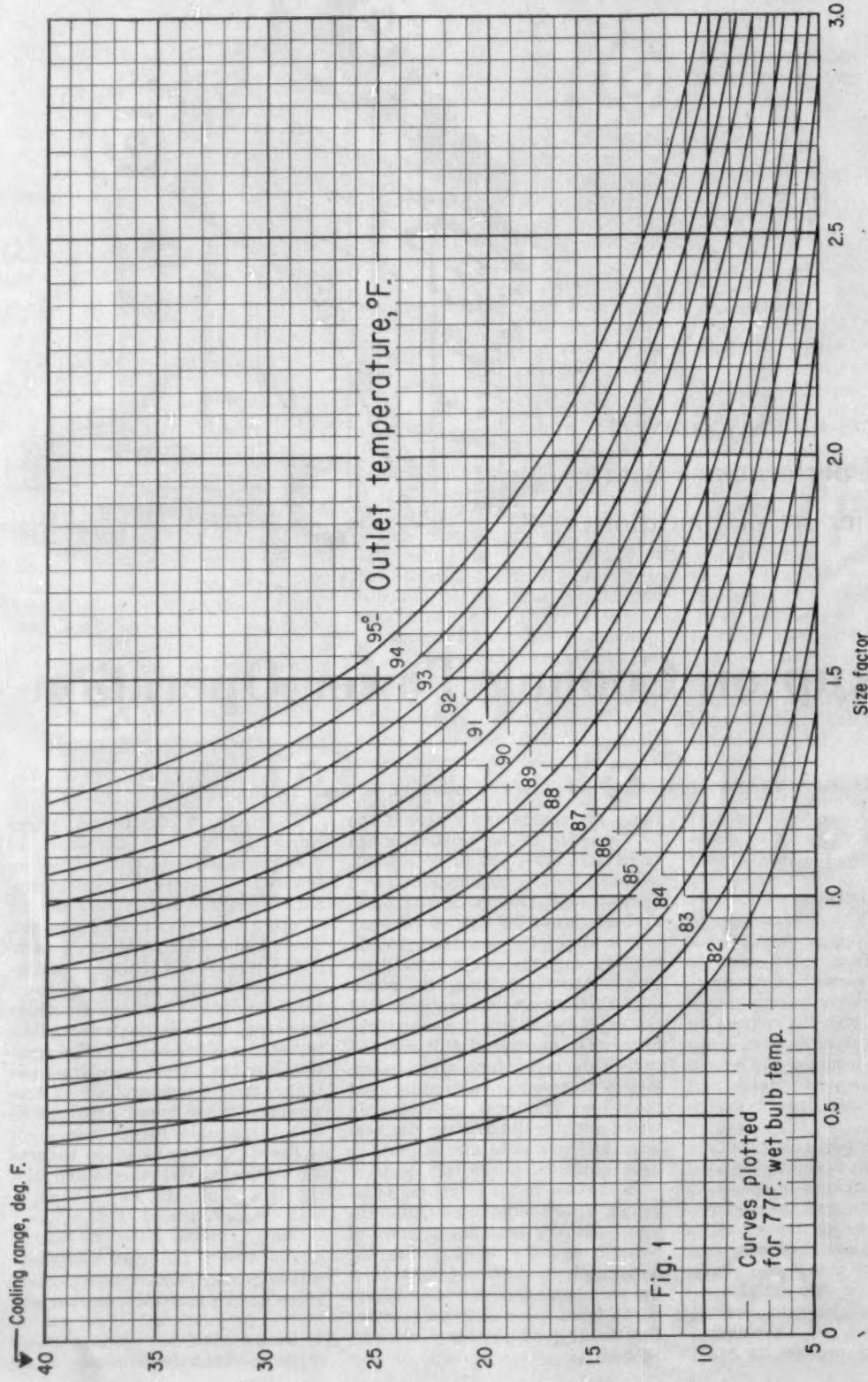
The charts on the following pages should be of great assistance to purchasers and operators of cooling towers in transferring the performance of a given tower from one set of operating conditions to another. They enable this to be done without involved and lengthy mathematical calculations. In developing these families of curves the authors condensed literally thousands of integrations of the basic Merkel equation into the simple form shown so that virtually any problem in converting cooling tower performance data can be solved with ease.

The curves are based on the well authenticated Merkel equation

$$KaV/L = \int_{T_1}^{T_2} \frac{dT}{\Delta H}$$

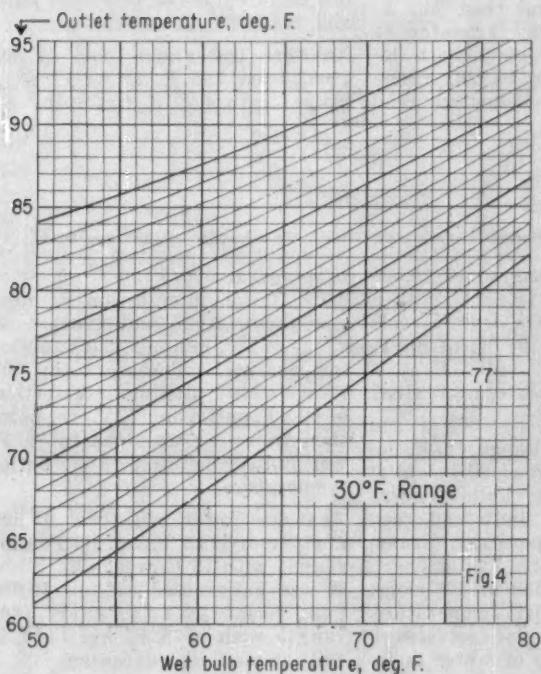
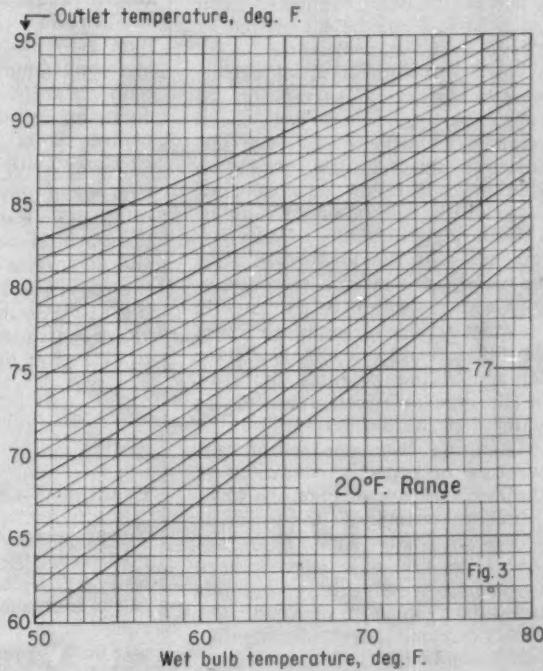
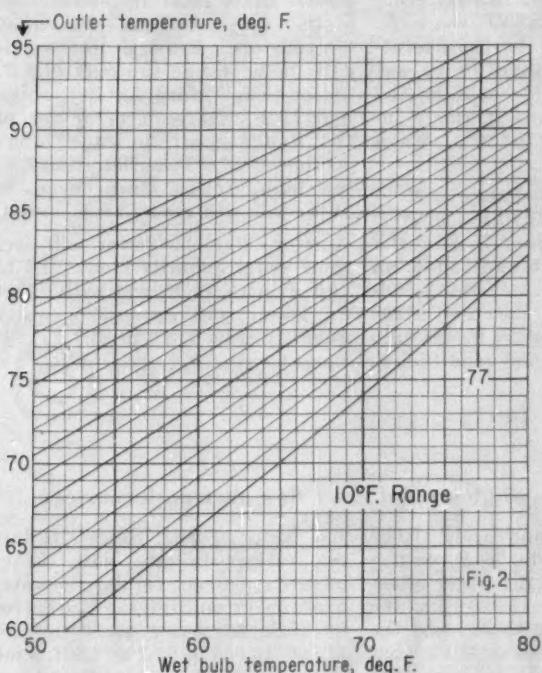
where  $K$  is a diffusion coefficient;  $a$  is water-air contact area per unit volume;  $V$  is tower volume per unit

See pp. 112-3 for working charts.  
See pp. 114-6 for examples of use.



Figs. 1 to 4, Copyright 1958 by N. P. Green & Associates.

## Four charts convert cooling tower performance data to other conditions



E. L. Bass



N. P. Green

EUGENE L. BASS has been connected with the cooling tower industry for 25 years, as design engineer for Lillie-Hoffmann and as vice-president and chief engineer for Water Cooling Equipment Corp. After a 10-year period on cooling tower research he became a partner of N. P. Green & Associates last spring.

NATHANIEL P. GREEN received his BS in ME from MIT in 1933. Since then he has been in engineering consultation and in cooling tower work. He organized Water Cooling Equipment Corp. in 1938, sold it in 1950, and last spring started his present concern to design, build and erect cooling towers.

of ground area;  $L$  is weight flow rate of the water;  $T$  is temperature; and  $\Delta H$  is change in enthalpy of the air through the tower. The group  $KaV/L$  can be considered as a mass transfer coefficient.

Any one design of tower can be represented by a correlation of  $KaV/L$  vs.  $L/G$ , where  $L/G$  is the weight flow ratio of water to air. For any fixed design of tower, whether counterflow or cross-flow, there will be only a single value of  $KaV$  and only a change in the characteristics of the tower will alter the value of  $KaV$  for that tower. Such changes might be a change in the amount, size or configuration of the filling baffles, a change in the depth of filling, or some alteration in the type or effectiveness of the water distribution system.

Changing from one set of temperature or capacity conditions to another does not change the physical characteristics of the tower, so it does not change  $KaV$ . Therefore, the curves can give a true representation of cooling tower capabilities under any set of conditions, once the capability under another set of conditions is known.

Since the curves enable us to conduct a performance check of a tower under conditions that may differ greatly from the design conditions, we thus have a tool that permits determining immediately whether the tower equals its guarantee, without the need for a possible long wait for full operating load or a high wet bulb temperature that might be needed to duplicate design conditions.

The curves have other important uses. For example, the performance of a given tower is known under certain operating conditions and it is necessary to find what will be the effect of a certain change in operating conditions. Perhaps it may be desired to increase the water flow through condensers and over the cooling tower to increase the flow velocity through the condenser tubes and therefore improve the condenser's heat transfer coefficient. In such a case the total heat load would be little affected but there would be a decrease in the temperature difference of water entering and leaving the tower.

Before making such a change it would be desirable to know what would be the new temperatures to and from the condenser in order to evaluate whether the increase in

### Example 1—What will be effect of change in wet bulb, range?

Tower is tested and cools an unknown quantity of water from 95 F. to 75 F. with a 60 F. wet bulb. Part 1—What will be the operating conditions with a 70 F. wet bulb? Part 2—What will be the operating conditions if range increases from 20° to 30°, with a 70 F. wet bulb?

Procedure, Part 1—Range is 95 F. to 75 F. so use 20° Range curves. Locate intersection of 75 F. outlet and 60 F. wet bulb and follow up the curves to 70 F. wet bulb, reading 81.1 F. outlet. Part 2—On 20° chart continue from 70 F. wet bulb to 77 F. wet bulb and read 85.5 F.

outlet. Transfer to Range vs. Size Factor chart, locating intersection of 20° range and 85.5 F. outlet temperature. Draw a line vertically to 30° range and read 87.9 F. outlet temperature for 30° range and 77 F. wet bulb. Transfer to 30° Range chart, locating intersection of 87.9 F. outlet and 77 F. wet bulb. Follow down curves to 70 F. w.b. and read 83.9 F. outlet.

Answer—Part 1: Tower will cool same water quantity from 101.1 to 81.1 F. with 70 F. wet bulb. Part 2: Tower will cool same water quantity from 113.9 to 83.9 F. (30° range) with 70 F. wet bulb.

### Example 2—How will increased water flow alter performance?

Tower is tested and cools 10,000 gpm. from 95 F. to 75 F. with a 60 F. wet bulb. If the water quantity is increased to 11,000 gpm., the range is increased to 30° and the wet bulb is increased to 70 F., what will be the change in operating conditions?

Procedure—Range is 95 to 75 F. so use 20° Range chart, locating intersection of 75 F. outlet and 60 F. wet bulb. Follow curves to 77 F. wet bulb and read 85.5 F. outlet temperature. Transfer to Range vs. Size Factor chart, locating intersection of 20° range and 85.5 F. outlet. Below this read

size factor of 0.81. Since size factor varies directly with water quantity, correct for larger water quantity by multiplying size factor by ratio of water quantities, or  $11,000/10,000 \times 0.81 = 0.891$ . Find intersection of corrected size factor 0.891 with new 30° range and read 88.9 F. outlet temperature. Transfer to 30° Range chart, locate intersection of 77 F. wet bulb and 88.9 F. outlet temperature, follow down curves to 70 F. wet bulb and read 85.0 F. outlet temp.

Answer—Tower will cool 11,000 gpm. from 115 F. to 85 F. (30° range) with a 70 F. wet bulb.

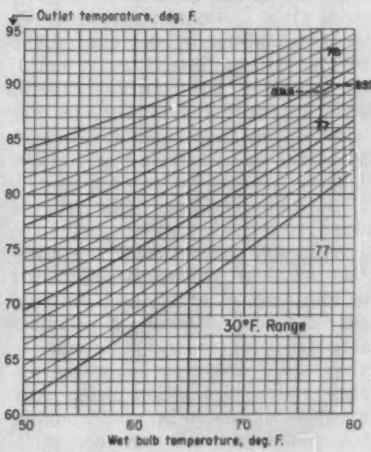
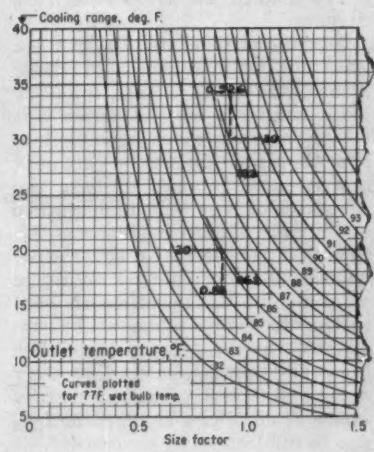
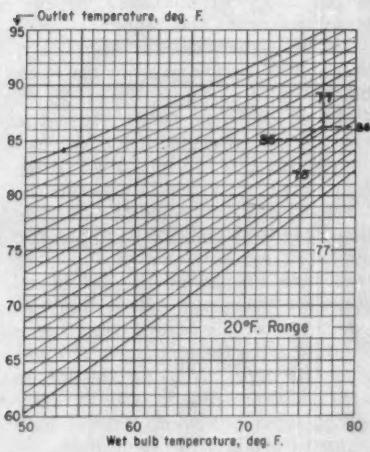
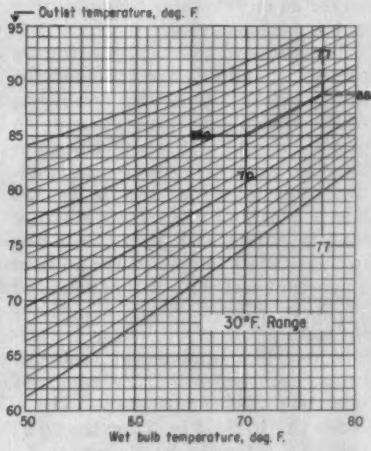
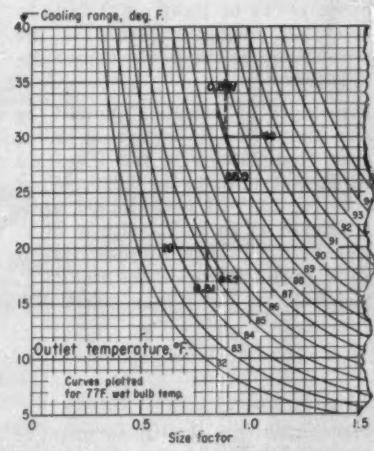
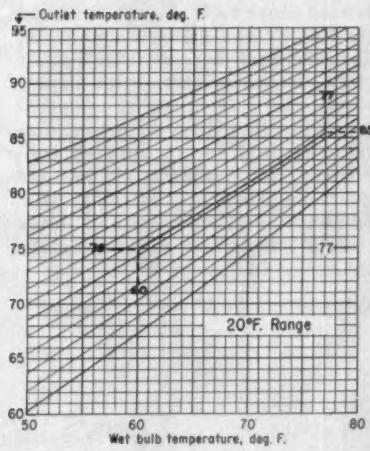
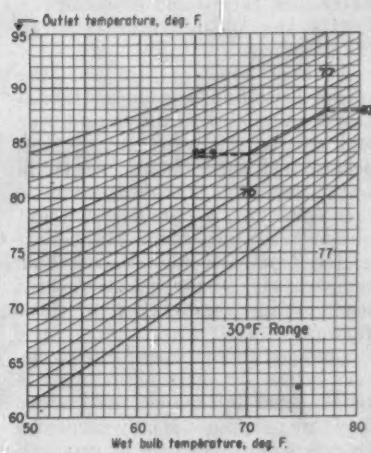
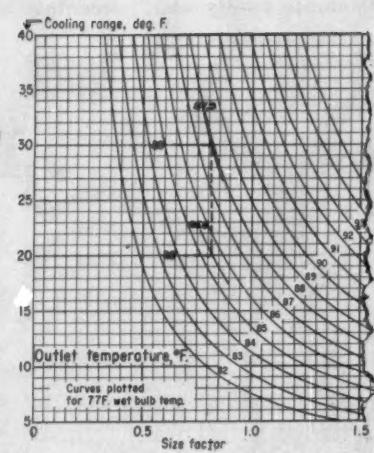
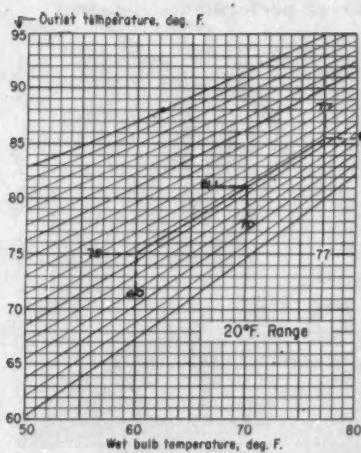
### Example 3—Does cooling tower meet its design specifications?

Tower is guaranteed to cool 10,000 gpm. from 118 F. to 88 F. with a 78 F. wet bulb. On test it cools 9,500 gpm. from 105 F. to 85 F. with a 75 F. wet bulb. Does it meet the performance guarantee?

Procedure—Range is 105 F. to 85 F. so use 20° Range chart, locating intersection of 85 F. outlet and 75 F. wet bulb. Follow curves up to 77 F. wet bulb and read 86.2 F. outlet temperature. Transfer to Range vs. Size Factor chart, locating intersection of 20° range and 86.2 F. outlet temperature. Read down to 0.88 size factor. Multiply this by ratio of water quan-

tities or  $10,000/9,500 \times 0.88 = 0.926$ . Find intersection of new size factor 0.926 and guaranteed range of 30°, reading 89.3 F. outlet temperature. Transfer to 30° Range chart, finding intersection of 89.3 F. outlet and 77 F. wet bulb, then following up slope to 78 F. wet bulb, reading 89.9 F. outlet temperature.

Answer—Tower will cool 10,000 gpm. from 119.9 F. to 89.9 F. (30° range) with 78 F. wet bulb. Since it was guaranteed to cool 10,000 gpm. from 118 F. to 88 F. (30° range) with a 78 F. wet bulb, it fails to meet its guarantee.



water flow rate would economically justify the added power required for pumping.

Another type of use for the curves is to find how an additional heat load applied to the same tower will change the water outlet temperature if there is no change in water quantity. The curves enable the operator to predict without guesswork what effect can be expected from a change in wet bulb temperature, water quantity, heat load, or any combination of these factors.

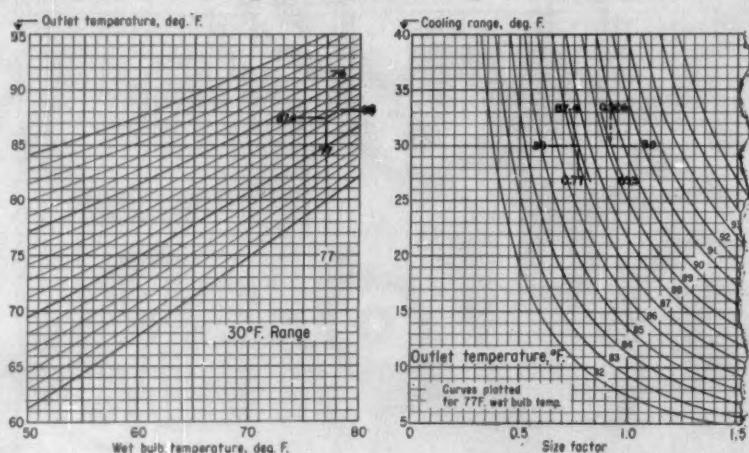
Changes in the tower due to deterioration or malfunctioning can be detected by use of the curves. For this purpose it is only necessary to compare tests made at intervals during the tower's life, converting all the tests to the same conditions of water quantity, heat load and wet bulb temperature and comparing the corrected outlet water temperatures in the various tests.

The full-size charts appearing on pages 112 and 113 are intended for the solution of actual problems, while the abbreviated charts on pages 115 and 116 show the solution of several typical examples. Referring to Figs. 1-4, note that Fig. 1 is a family of curves relating cooling range and size factor for various outlet temperatures and for a constant wet bulb temperature of 77 F. In Figs. 2, 3 and 4 we have three families of curves which relate wet bulb and outlet temperatures, each for a definite range of inlet to outlet temperature. Fig. 2 is for the 10 F. range, Fig. 3 for the 20 F. and Fig. 4 for the 30 F. range.

Here "range" is the difference between inlet and outlet water temperatures. Note that the 77 F. wet bulb line is emphasized on each of these plots. All outlet temperatures to be transferred from one of the cooling range curves, Figs. 2, 3 or 4, to the size factor curve, Fig. 1, must be converted to a 77 F. wet bulb before the transfer. And in transferring back from Fig. 1, Figs. 2, 3 or 4 must be entered at the 77 F. wet bulb line. This will be clear from the examples.

Although theoretically the accuracy of these curves is unaffected by the amount of water circulated over the cooling tower, a practical safe limit of variation would be about 20% above or below the design water circulation rate. Any greater variation in most cooling tower designs will produce suffi-

#### Example 4—By what percentage is tower performance deficient?



Since tower of Example 3 fails to meet its guarantee, what is the percentage of the performance deficiency?

**Procedure**—Example 3 showed the size factor of a tower to cool 10,000 gpm. from 119.9 F. to 89.9 F. with a 78 F. wet bulb to be 0.926. What size factor will cool 10,000 gpm. from 118 F. to 88 F. with a 78 F. wet bulb? Locate intersection of 88 F. outlet temperature and 78 F. wet bulb on 30° Range chart, fol-

lowing slope to 77 F. wet bulb and reading 87.4 F. outlet temperature. Transfer to Range vs. Size Factor chart, locating intersection of 30° range and 87.4 F. outlet temperature. Reading directly below, size factor is 0.77 for guaranteed conditions. For cooling tower to meet guarantee its size must be  $(0.926/0.77) 100 = 120\%$  of size of tower tested. Therefore, tower must be increased in size by 20%.

**Answer**—Deficiency is 20%.

cient upset in the uniformity of water distribution to change the value of  $KaV$ . Since the basic assumption of the curves is the constancy of  $KaV$ , they should not be used for excessive water rate changes.

Variations in altitude above sea level will not introduce appreciable errors into use of the charts.

In making a cooling tower test run, it is much more important to have the water circulation rate near design capacity than to have the heat load or wet bulb temperature at or near design conditions. Although it is true that a small error will result from changes in range or wet bulb temperature in converting to design temperature conditions, this will actually be less than the temperature reading error during the test. The inaccuracy comes from slight changes in  $L/G$  due to differences in air density.

The simplest way to grasp the use of these charts is to use them. Therefore, we have provided four typical examples which illustrate the types of problem that can be solved and will doubtless suggest many others to the reader.

In the examples, for simplicity, the cooling range has always been taken at 20 F. (Fig. 3) or 30 F. (Fig. 4), with no cases where the range is intermediate between charts, e.g., 18 F. or 23 F. However, such intermediate temperatures are easily handled by straight-line interpolation. For example, for an 18 F. range, work the problem with both Fig. 2 and Fig. 3 and interpolate between the two answers. After the reader has become familiar with the charts he will find that the error in using the single nearest range chart will be very slight, especially when the wet bulb temperature is 70 F. or higher.

## New Aids to Find

# Shellside Heat Transfer Coefficient

## And Pressure Drop for Water

NING HSING CHEN, Heat Transfer Div., M. W. Kellogg Co., Jersey City, N.J.\*

THIS installment of the current series on short-cut heat exchanger calculations deals specifically with shellside water flow. Applicability of all information presented is again limited to segmental baffled, tubular heat exchangers.

### Find Heat Transfer Coefficients

Substitution of temperature-dependent physical properties of water into Eq. (4) of a prior article<sup>1</sup> yields a series of equations for shellside heat transfer coefficient,  $h_s$ , as a function of shellside geometric mean mass velocity,  $G_s'$ . For convenience, Fig. 1 shows these equations in graphic form.

**Problem 1**—Find the shellside heat transfer coefficient for water flowing through a 19½-in. I.D. shell at a rate of 54,100 lb./hr. The exchanger has 292, ½-in. x 16 BWG tubes (two tube passes) arranged on a ½-in. triangular pitch into 16 rows. Spacing between each of the 38 baffles is 4.5 in.; 20% of baffle

\* To meet your author, see *Chem. Eng.*, June 30, 1958, p. 140.

is cut out. Bulk water temperature averages 100 F.

**Step 1**—Calculate geometric mean mass velocity. From the prior article<sup>1</sup>,  $G_s' = 77$  lb./sec., sq. ft.)

**Step 2**—Enter Fig. 1 at  $G_s' = 77$ , draw a horizontal line to 100 F., and follow the sloping guide line to read 590 on the  $h_s$  scale. Multiply this value by the tube-size correction factor to give a corrected shellside heat transfer coefficient of  $0.926 \times 590 = 545$  Btu./hr., sq. ft., deg. F.)

### Calculate Pressure Drop

Based on Eqs. (8) and (12) in a prior article<sup>1</sup>, Figs. 2 and 3 are useful for calculating the shellside pressure drop across tube bundles,  $\Delta p_s'$ , and through baffle openings,  $\Delta p_b'$ . Summation of these two values gives the over-all pressure drop for water in turbulent flow. Likewise, Figs. 4 and 5 aid computations for streamline flow.

**Problem 2**—For an exchanger having the same specifications as that in **Problem 1**, find the shellside pressure drop for water in turbulent flow at a rate of 54,100 lb./hr. Average water temperature is 90 F.

**Step 1**—Calculate<sup>1</sup> crossflow mass velocity,  $G_s$ , as 96 lb./sec., sq. ft.) On Fig. 2 read  $\Delta p_s'/N_r$  as 0.0105 at  $G_s = 96$ . Temperature correction factor<sup>2</sup> is 0.87; tube-arrangement correction factor is 1.058. Corrected  $\Delta p_s'/N_r = 0.0105$

### Heat Transfer Coefficients for Water on Shellside

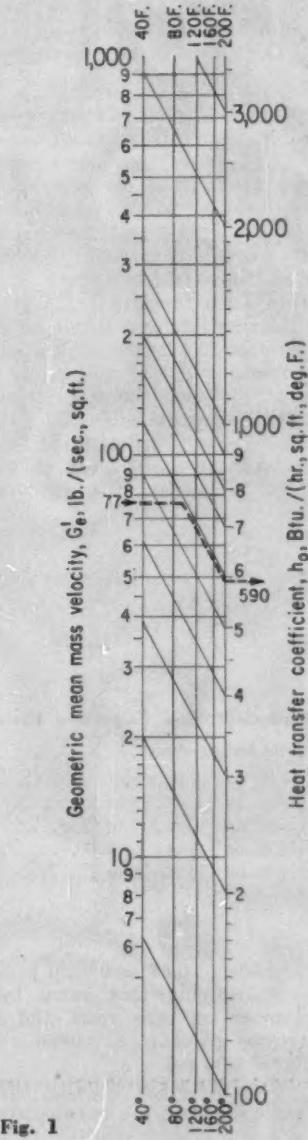


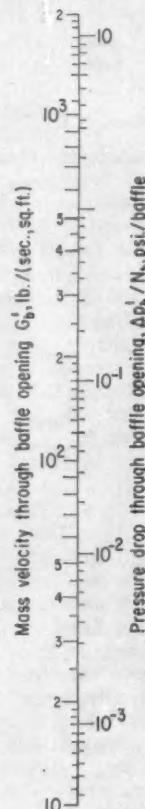
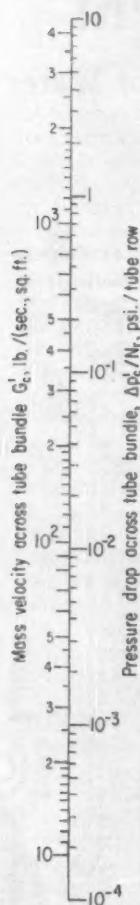
Fig. 1

### Correction Factors for Fig. 1

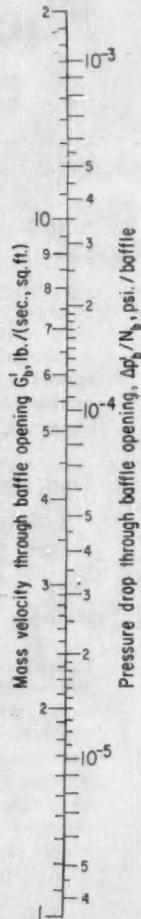
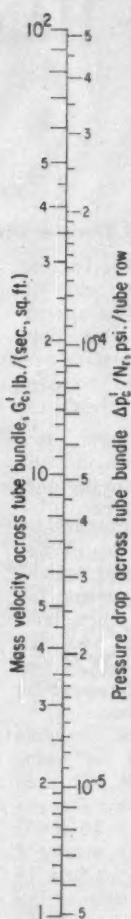
Tube Size	Factor
5/8 in. O.D.	1.000
3/4 in.	0.926
1 in.	0.825
1 1/4 in.	0.756

## Four Charts Aid Calculation of Shellside Pressure Drop

## For Turbulent Flow . . .

Fig. 2 gives  $\Delta p'_c/N_c$ Fig. 3 gives  $\Delta p'_b/N_b$ 

## For Streamline Flow . . .

Fig. 4 gives  $\Delta p'_c/N_c$ Fig. 5 gives  $\Delta p'_b/N_b$ 

## Turbulent Flow Correction Factors

Tube Arrangement	Factor
3/4 in. on 1 1/2 in., $\Delta$ . . . . .	1.058
3/4 in. on 1 in., $\Delta$ or $\square$ . . . . .	1.000
1 in. on 1 1/4 in., $\Delta$ or $\square$ . . . . .	1.000
1 1/4 in. on 1 1/8 in., $\Delta$ or $\square$ . . . . .	0.955
1 1/2 in. on 1 1/8 in., $\Delta$ or $\square$ . . . . .	0.922

$$\times 1.058 \times 0.87 = 0.0096 \text{ psi./row.}$$

Multiplying this value by the number of tube rows and baffle crosses gives  $\Delta p'_c = 0.0096 \times 16 \times 39 = 6.00 \text{ psi.}$

Step 2—Mass velocity through baffle opening,  $G'_b$ , is calculated<sup>1</sup> to

be 62.5 lb./sec., sq. ft.) On Fig. 3, read  $p'_b/N_b = 0.0135 \text{ psi./baffle}$  at  $G'_b = 62.5$ . Or,  $p'_b = 0.0135 \times 38 = 0.512 \text{ psi.}$

Step 3—Assuming a safety factor of 1.2,  $\Delta p'_c = (6.00 + 0.512) \times 1.2 = 7.8 \text{ psi.}$

## Streamline Flow Correction Factors

Tube Arrangement	Factor
3/4 in. on 1 1/2 in., $\Delta$ . . . . .	1.340
3/4 in. on 1 in., $\Delta$ or $\square$ . . . . .	1.000
1 in. on 1 1/4 in., $\Delta$ or $\square$ . . . . .	1.000
1 1/4 in. on 1 1/8 in., $\Delta$ or $\square$ . . . . .	0.815
1 1/2 in. on 1 1/8 in., $\Delta$ or $\square$ . . . . .	0.671

Use these same three steps with Figs. 4 and 5 for streamline flow calculations.

## REFERENCES

1. Chen, N. H., *Chem. Eng.*, Oct. 20, 1958, p. 153.
2. Chen, N. H., *Chem. Eng.*, Nov. 17, 1958, p. 155.

# Estimate Efficiency in Mass Transfer

Review methods for calculating over-all, plate and point efficiencies in bubble-cap or sieve-plate columns during distillation or absorption.

JAMES O. OSBURN, State University of Iowa, Iowa City, Ia.\*

WHEN we design equipment for stage contacting, we first calculate the number of theoretical stages. In making this calculation [*Chem. Eng.*, July 14, 1958, p. 147], we assume that equilibrium exists between the streams leaving the stage. The ideal condition seldom occurs in actual operation. Hence, the number of actual stages is greater than the number of theoretical stages we calculate.

As another step in the design, we must estimate or calculate the stage efficiency. This step is just as important as the first one for correct design, but it has received considerably less attention. In this article, we review methods of calculating stage efficiencies for bubble-cap and sieve-plate columns for distillation and absorption.

## What Is Efficiency?

First, let's consider mass transfer in bubble-cap columns for distillation or absorption. Three different efficiencies are commonly used. These are over-all column efficiency, plate efficiency and local or point efficiency.

Over-all column efficiency is the ratio of the theoretical number of plates given by a column to the actual

\* To meet your author see *Chem. Eng.*, Mar. 24, 1958, p. 169.

number of plates in the column. This is the simplest kind and the one we eventually use. If we first calculate the theoretical number of plates  $N$ , we then find the actual plates  $N'$  from the over-all efficiency.

$$N' = N/E \quad (1)$$

Over-all efficiency is an average of the efficiencies on the various plates. We can illustrate the meaning of the plate efficiency and point efficiency by Fig. 1. As shown in the diagram, the vapor concentration  $y_1$  and the concentration of the liquid  $x_{2A}$  leaving the plate, together, locate a point on the operating line.

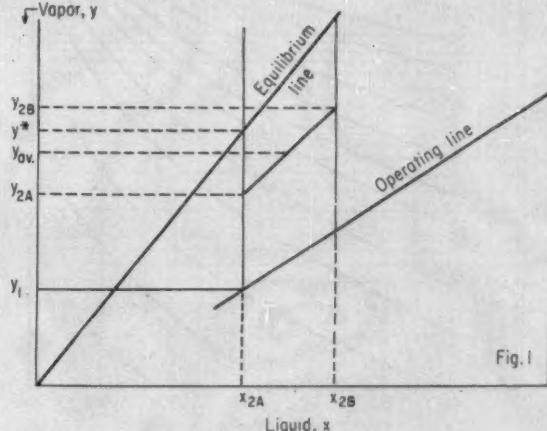
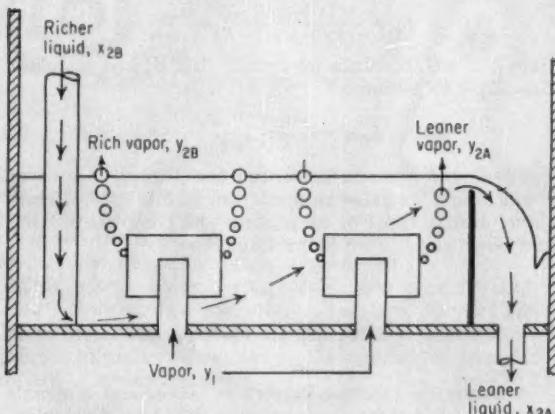
As the liquid flows across the plate, it becomes depleted in the more volatile component by contact with the vapor. To end up at  $x_{2B}$ , the liquid must have entered the plate with some higher composition  $x_{2B}$ .

If the plate were a theoretical stage, the composition of the vapor would be the equilibrium concentration  $y^*$ . Because a bubble of vapor does not have enough time to come to equilibrium with the liquid, the vapor rising above the liquid at  $A$  will have a composition shown as  $y_{2A}$ . This composition depends on the point efficiency at  $A$  which is defined as

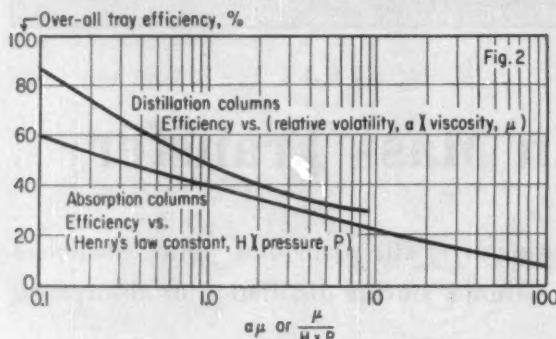
$$E_p = \frac{y_{2A} - y_1}{y^* - y_1} \quad (2)$$

Depending on the point efficiency at  $B$ , the vapor com-

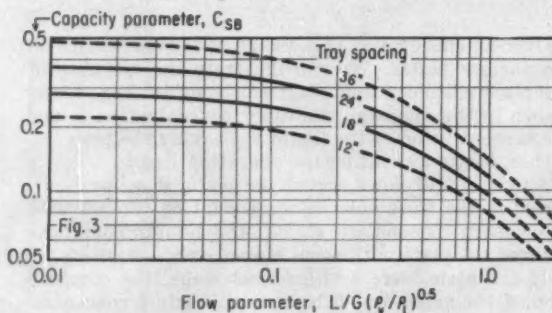
## Phase concentrations determine plate and point efficiencies



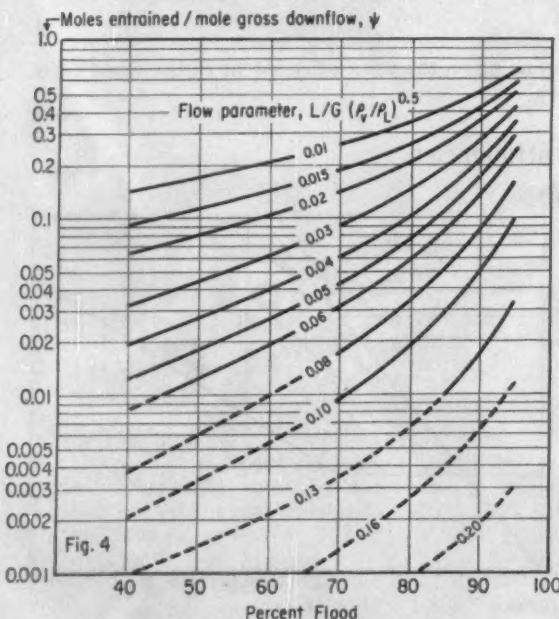
## Estimate approximate column efficiency



## Estimate flooding limit at 100% entrainment



## Find entrainment, bubble-caps only



position at  $B$  is  $y_{av}$ . Above the plate, the vapor becomes mixed, to give the average composition  $y_{av}$ .

The plate efficiency, sometimes called the Murphree plate efficiency, is defined as

$$E_{mv} = \frac{y_{av} - y_1}{y^* - y_1} \quad (3)$$

When we know the plate efficiency at different points in the column, we can use it in stepping off plates on an  $x$ - $y$  diagram.

With these definitions in mind, we show how to use some correlations of efficiency.

### When to Use Over-all Efficiency

A useful correlation of column efficiency which has proved satisfactory for several commercial columns of conventional design was developed by O'Connell [*Trans. AIChE*, 42, 741-55 (1946)]. He found that the over-all column efficiency depends mainly on the relative volatility of the key components and the viscosity of the feed. This relation is shown in Fig. 2 for distillation columns and for absorbers. With this relationship, we can calculate over-all coefficients with a minimum of information. However, it may give poor results if we try to apply it too widely.

In general, experiments with laboratory columns have shown that the efficiency depends on the extent of contact between phases and on the mass transfer coefficients. These, in turn, are functions of the design details of the plate, the flow rates of the liquid and vapor and the nature of the phases. For correlations with wider applications than the O'Connell method, we must use point and plate efficiencies.

### Find Plate Efficiency From Point Efficiency

Theory and experiment allow us to correlate and predict point efficiencies from design parameters and phase properties. To find the number of actual plates, we need the plate efficiency. Let's see how these two efficiencies are related.

The relationship depends on three factors:

- Slope of the equilibrium curve,  $m$ .
- Ratio of gas to liquid flow rates,  $G/L$ .
- Fraction of liquid mixing on the plate.

Oliver and Watson [*AIChE Journal*, 2, 18-25 (1956)] give the following equation relating the two efficiencies.

$$E_p = \frac{\ln [1 + \lambda (1 - F) E_{mv}]}{\lambda (1 - F)} \quad (4)$$

Here  $\lambda = mG/L$ . Since we usually find  $E_p$  and calculate  $E_{mv}$ , Eq. (4) becomes

$$E_{mv} = \frac{e^{E_p \lambda (1 - F)} - 1}{\lambda (1 - F)} \quad (5)$$

Oliver and Watson measured the degree of mixing  $F$  and found its value ranges from 0.25 to 0.75. Previously, assumptions of no mixing and complete mixing had been made. For no mixing,  $F = 0$ .

$$E_{mv} = \frac{1}{\lambda} (e^{E_p \lambda} - 1) \quad (6)$$

For complete mixing,  $F = 1$  and Eq. (5) changes to

$$E_{mv} = E_p \quad (7)$$

A numerical example illustrates Oliver and Watson's equation. A column is separating ethylene dichloride-

toluene. For certain operating conditions, the point efficiency is 70%. Slope of operating line  $dy/dx = m = 1$ .  $G = 12$  lb. moles/hr.-sq. ft. and  $L = 10$  lb. moles/hr.-sq. ft. Calculate the plate efficiency for three assumptions: (1) no liquid mixing on a plate, (2) complete mixing and (3) 50% mixing.

First, we'll find  $\lambda = mG/L = 1.2$ . For no mixing  $E_{w0} = 1.10$ . For 50% mixing,  $E_{w0} = 0.87$  and for complete mixing  $E_{w0} = E_p = 0.70$ .

### Entrainment Lowers Efficiency

A certain amount of liquid is usually carried upward by the vapor to the next plate in the form of spray. Since the liquid concentration is lower than that of the vapor, this entrainment causes a lowered efficiency. The effect of entrainment on efficiency is given by the Colburn equation.

$$E_w = \frac{E_p}{1 + eE_p} \quad (8)$$

where  $E_w$  is the wet-efficiency,  $E_p$  the plate efficiency without entrainment and  $e$  the entrainment rate, lb. moles per lb. mole of downflow without entrainment.

To use Eq. (8), we need some method of estimating the entrainment rate  $e$ . Such a method is given by Fair and Matthews [Pet. Refiner, Apr. 1958, p. 153] and is summarized here in Figs. 3 and 4. The vapor velocity corrected for density at the flood point is given by Fig. 3. Here the entrainment is 100%. For lower velocities, the entrainment falls off as shown in Fig. 4.

We now have a complete method for calculating efficiencies where there is entrainment. Solving the following example shows how to use Figs. 3 and 4.

Calculate the true plate efficiency for a distillation column for these conditions:

Liquid rate, $L$ .....	25,000 lb./hr.
Vapor rate, $G$ .....	30,000 lb./hr.
Liquid density, $\rho_L$ .....	50 lb./cu. ft.
Vapor density, $\rho_V$ .....	0.08 lb./cu. ft.
Vapor velocity, $U$ .....	4 fps.
Tray spacing.....	12 in.
Plate efficiency, no entrainment.....	90%

To find the true plate efficiency, we must calculate the percent flooding and entrainment rate for the column.

Flow parameter  $(L/G)(\rho_V/\rho_L)^{0.5} = 0.033$   
 Flooding  $C_{SB}$  from Fig. 3 = 0.22  
 Actual  $C_{SB} = 4(0.08/50 - 0.08)^{0.5} = 0.16$   
 Percent flood =  $(0.16/0.22) 100 = 73\%$   
 Entrainment  $\psi$  from Fig. 4 = 0.091  
 Entrainment rate  $e = \psi/(1 - \psi) = 0.091/0.909 = 0.10$   
 Substituting in Eq. (8) yields

$$E_w = 0.90/[1 + (0.90)(0.10)] = 0.825 \text{ or } 82.5\%$$

### Adjust Efficiency for Change in System

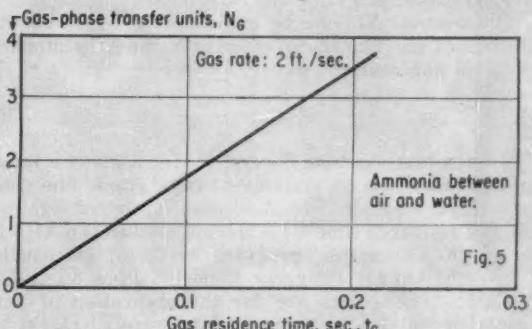
Let's now consider the problem of estimating point efficiencies. For the first case, suppose that we have a certain column whose efficiencies are known for some systems over a range of flow conditions. How do we predict the efficiency for a new system?

This can be done best through the transfer unit theory as described by Gerster, Colburn, Bonnet and Carmody [Chem. Eng. Prog., 45, 716-24 (1949)].

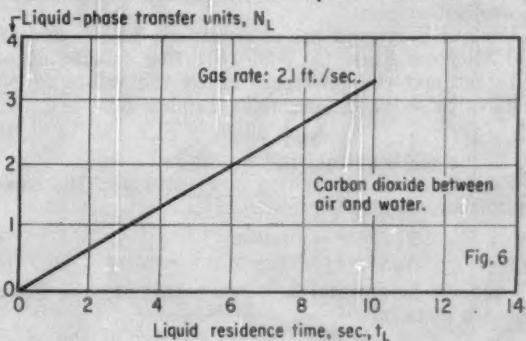
Point efficiency is related to the number of transfer units  $N_{eq}$  by the equation

$$N_{eq} = -\ln(1 - E_p) \quad (9)$$

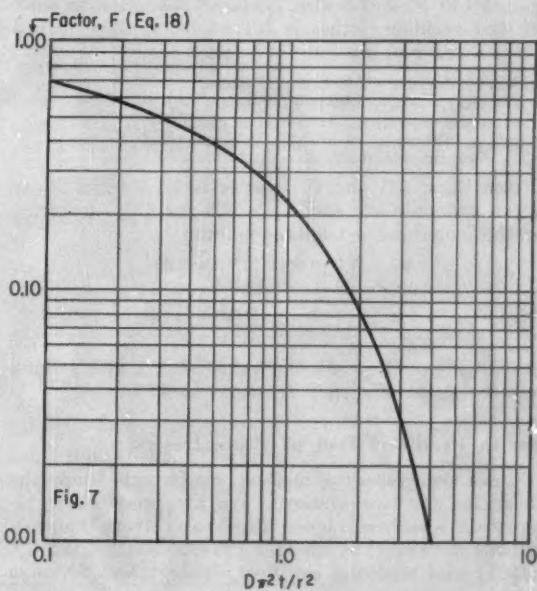
### Residence time controls gas-transfer units



### Residence time controls liquid-transfer units



### F-factor helps predict efficiencies



For a discussion of transfer units, see *Chem. Eng.* Aug. 11, 1958, p. 147.

The over-all  $N_{og}$  can be expressed in terms of the number of gas film transfer units  $N_g$  and the number of liquid film units  $N_L$  as

$$\frac{1}{N_{og}} = \frac{1}{N_g} + \frac{mG/L}{N_L} \quad (10)$$

We can best evaluate  $N_g$  and  $N_L$  for a given column by measurements on systems where a single film controls. For example, Fig. 5 shows  $N_g$  plotted against the gas residence time for a column used in the AIChE Research Committee program on tray efficiencies ["Fourth Annual Progress Report," June 30, 1956, AIChE]. These data are for the absorption of ammonia in water. The over-all data were corrected to give  $N_g$  by estimating  $N_L$  and using Eq. (10). Humidification experiments have also been used. These give  $N_g$  directly because there is no liquid film.

For the same column and about the same gas velocity, the data on absorption of  $\text{CO}_2$  in water as shown in Fig. 6 give  $N_L$ . In this case, the gas-film resistance is negligible.

For one particular set of conditions we can find  $N_L$  and  $N_g$  from Figs. (5) and (6). For distillation of different materials, we can adjust the values of  $N_L$  and  $N_g$  by using the Schmidt number  $Sc$ .

$$Sc = \mu/\rho D_s \quad (11)$$

$D_s$  is the molar diffusivity, sq. ft./hr.

For the same volumetric flow rates and the same equipment, we find:

$$N_g (Sc)^{1/2} = \text{constant} \quad (12)$$

$$N_L (Sc)^{1/2} [Z_e/(Z_f - Z_e)] = \text{constant} \quad (13)$$

$Z_f$  is foam height and  $Z_e$  is the height of clear liquid above a plate.

For  $N_g$ , we use the Schmidt number of the vapor and for  $N_L$  that of the liquid. The term  $Z_e/(Z_f - Z_e)$  is a correction for differences in foam height.

Using the data in Figs. (5) and (6), estimate the point efficiency for a column separating isobutane from 1-butene in the presence of 85 mole percent furfural at 140 F. and 5 atm. Column operation is such that gas residence time is 0.1 sec., liquid residence time is 4 sec. and gas rate is 3 fps.

For  $\text{CO}_2$ -water,  $Sc = 550$  in liquid phase.

For  $\text{NH}_3$ -air,  $Sc = 0.96$  in gas phase.

For isobutane-1-butene,  $Sc = 0.71$  in gas phase.

For butane-furfural,  $Sc = 1,320$  in liquid phase.

For the conditions used  $mG/L = 0.92$ .

From Figs. (5) and (6) respectively, we find  $N_g = 1.7$  for ammonia-air and  $N_L = 1.3$  for  $\text{CO}_2$ -water. For the isobutane-1-butene column,

$$N_g = 1.7 (0.96/0.71)^{1/2} = 2.08$$

$$N_L = 1.3 (550/1,320)^{1/2} = 0.84$$

$$\frac{1}{N_{og}} = \frac{1}{2.08} + \frac{0.92}{0.84} = 1.57$$

Substituting in Eq. (9) the value of  $N_{og}$  and solving gives the point efficiency  $E_p$  equal to 47%.

### How to Predict Effect of Plate Design

To use the preceding method, we have to know the efficiencies for two systems. We also need some information about residence times and froth heights. Methods developed by Geddes [*Trans. AIChE*, 42, 79, (1946)] and modified by West, Gilbert and Shimizu

[*Ind. Eng. Chem.*, 44, 2470 (1952)] may be used to calculate point efficiencies from hydrodynamic and mass transfer theory.

Geddes bases his method on the equation:

$$\ln (1 - E_p) = - 3K_a t/r \quad (14)$$

This equation is derived for transfer of mass from a bubble of radius  $r$  during the time  $t$  it takes to travel through the quiet liquid on a plate. The rate of mass transfer is given by the mass transfer coefficient  $K_a$ . No account is taken of foaming nor of gas turbulence inside the bubbles.

We calculate bubble radius  $r$  from the correlation:

$$r = \left[ \frac{\sigma (h_s + w)}{\rho_L - \rho_s} \right]^{1/2} \quad (15)$$

Here  $\sigma$  is surface tension,  $h_s$  is slot height,  $w$  is slot width and  $\rho$  the density.

Time of contact is calculated from the height of the liquid  $h$  above the midpoint of the slot and the bubble radius.

$$t = h/4r^{0.57} \quad (16)$$

We find the mass transfer coefficient from the two film coefficients as follows.

$$\frac{1}{K_a} = \frac{1}{k_g} + \frac{1}{Rk_L} \quad (17)$$

In Eq. (17),  $R$  is the equilibrium constant  $C_o^*/C_L$ .

We calculate  $k_g$  from the diffusion coefficient  $D$ , assuming no mixing inside the drop. The theoretical curve is shown in Fig. 7 relates the factor  $F$  to  $D$ ,  $r$ ,  $t$  and the number of plates. Hence,

$$k_g = -(r/3t) \ln F \quad (18)$$

For  $k_L$ , the time of liquid contact  $t_s$  is given by

$$t_s = 2rt/h \quad (19)$$

From an empirical correlation, we get  $k_L$

$$k_L = 1.13 (r/t_s)^{1/2} \quad (20)$$

This procedure was used successfully by Geddes to predict the efficiencies of several operating columns. The article by West, Gilbert and Shimizu points out that some of the assumptions are in error but that the errors appear to be compensating. The modified method proposed by them is not as successful as the original one. More information is needed about foam height, turbulence in bubbles and bubble size.

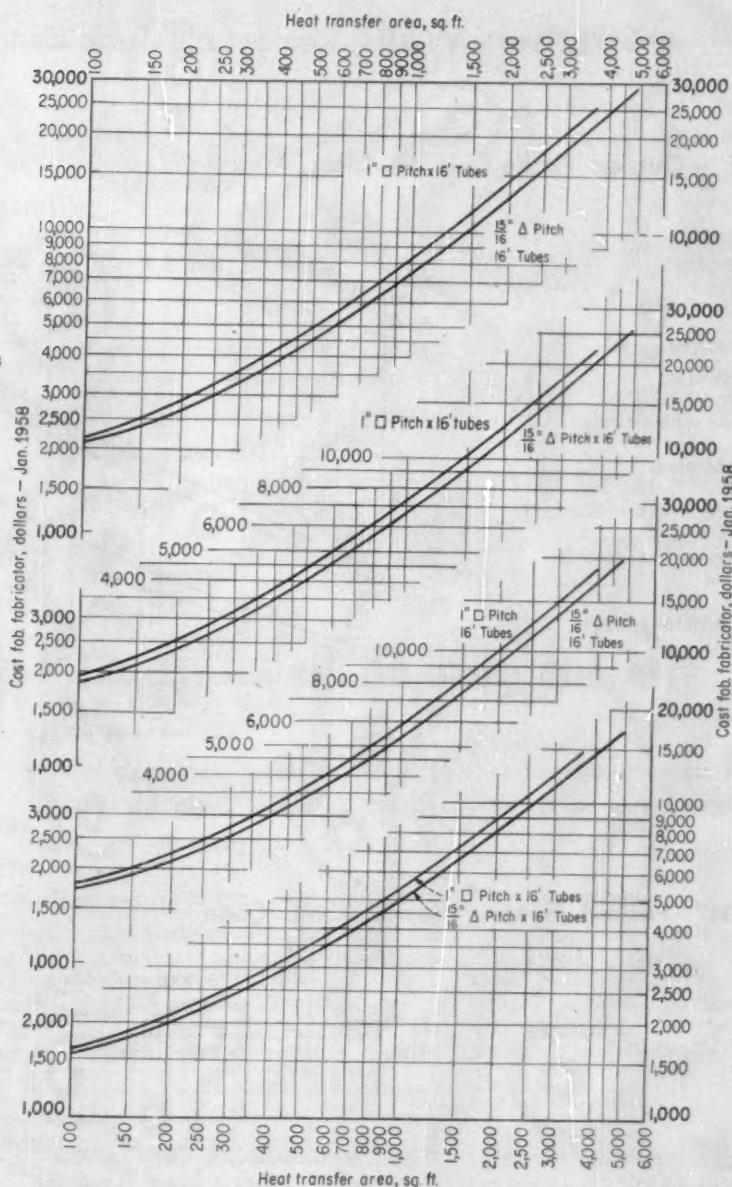
### Perforated Plates Need Study

Not as much attention has been given to perforated plate columns. A modification of the Geddes method was applied to perforated plates by West, Gilbert and Shimizu. They present data on fraction voids in the foam and on the interfacial area for three columns. The Geddes method should apply equally well to perforated plates. Effect of gas velocity on over-all plate efficiency was reported by Umholtz and Van Winkle [*Pet. Refiner*, July 1955, p. 114].

### Design Details

The final step in design, that of specifying items such as column diameter; shape, size and number of caps; sizes of weirs and downspouts, is outside the scope of this series. An excellent summary of this phase of design is given by Bolles ["Optimum Bubble Tray Design," *Pet. Processing*, Feb. 1956, p. 65; Mar. 1956, p. 82; Apr. 1956, p. 73 and May 1956, p. 109].

H. J. De Lameter, Chairman, AACE Heat Exchanger Cost Committee



#### Let Us Hear From You

Send your cost data, preferably in tabular or graphical form and with a minimum of text, to CE Cost File Editor, Chemical Engineering, 330 West 42nd St., New York 36, N. Y. Any legible form is acceptable. We will pay regular space rates for all published material.

## Struthers Wells, Removable Tube Bundle

### Type "E"—Outside Packed, TEMA Class A

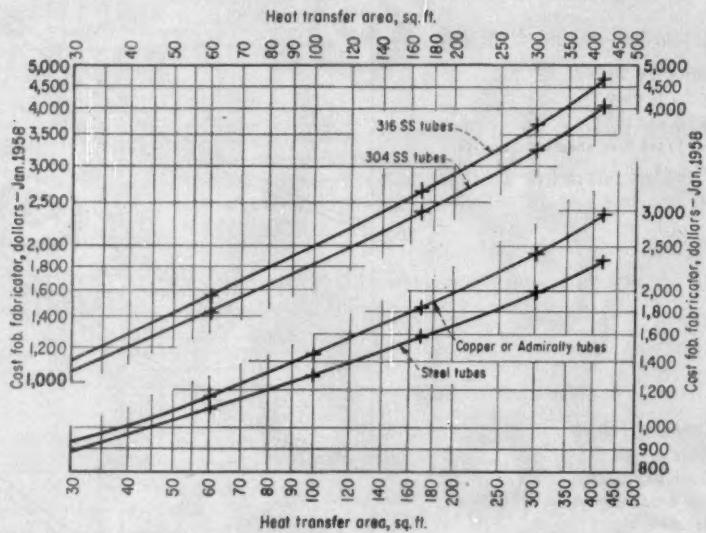
316 Stainless steel  
 $\frac{3}{4}$ " OD x 18 BWG  
 316 stainless tube sheets and baffles  
 8

304 Stainless steel  
 $\frac{3}{4}$ " OD x 18 BWG  
 304 stainless tube sheets and baffles

150 psi. shell and tube 500F.  
 Carbon steel shell

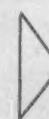
Copper or Admiralty tubes  
 $\frac{3}{4}$ " OD x 16 BWG 400F.  
 8

Steel tubes  
 $\frac{3}{4}$ " OD x 16 BWG 400F.

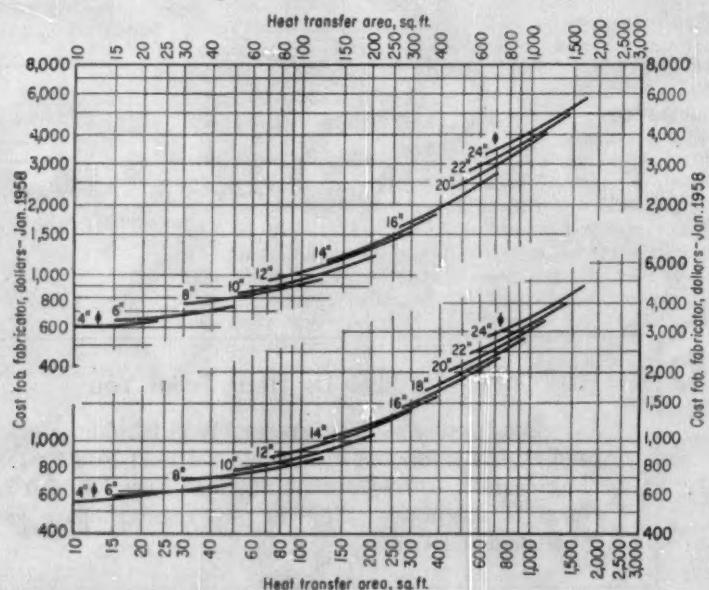
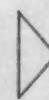


### Type "H"—Packed Floating Head, ASME Code

Admiralty tubes  
 $\frac{5}{8}$ " OD x 18 BWG  
 75 psi. design press.  
 Naval brass tube sheets  
 Steel shell, cast iron heads

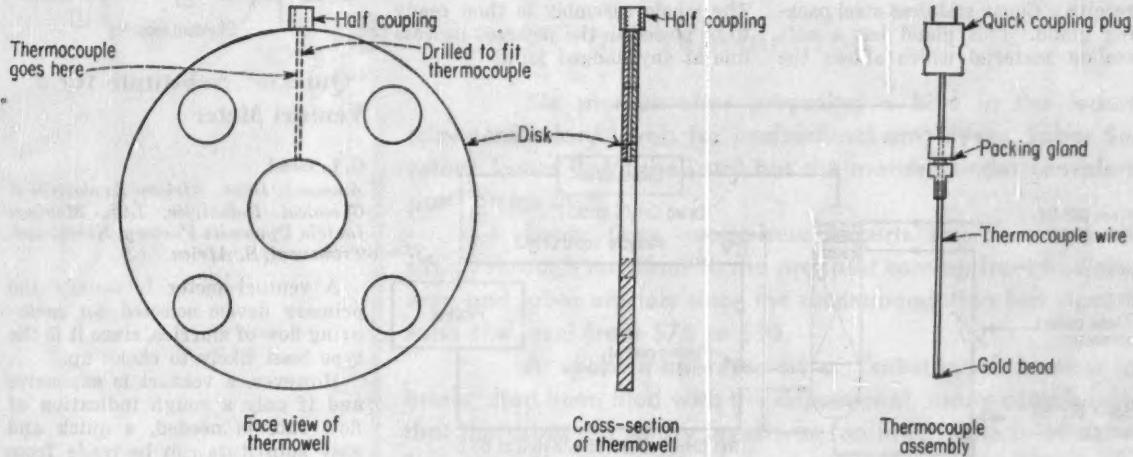


Steel tubes  
 $\frac{5}{8}$ " OD x 16 BWG  
 75 psi. design press.  
 All steel construction, cast iron heads



PRACTICE . . .

## PLANT NOTEBOOK EDITED BY T. R. OLIVE



### Flange-Inserted Thermowell Easy to Install

Although developed to simplify thermocouple installations in jacketed pipe, this idea is equally good for any flanged joint.

**W. M. Robinson and F. H. Allen**

Respectively, Senior Instrument Engineer and Instrument Engineer, Chemstrand Corp., Pensacola, Fla.

We were faced with the problem of more accurately measuring the temperature of a process stream flowing in a jacketed pipe. In order to do so without any revision of the existing piping, we developed the thermocouple assembly and thermowell shown above, for insertion directly in any flanged joint. In addition to the ease of installation, this arrangement exposed the thermocouple directly to the process stream and gave quick response with a more accurate indication of process stream temperature.

The thermocouple consists of a short length of  $\frac{1}{16}$ -in. O. D. Ceramo thermocouple wire. This material makes use of thermocouple wire conductors surrounded by a metal oxide insulation sheathed in stainless steel. The stainless steel sheath is ground back a fraction of an inch at each end, with a gold bead formed over the exposed wires on one end, using gold foil and an alcohol torch. A quick-coupling

plug is fastened to the other end to facilitate connecting the thermocouple to the lead wires.

The thermowell is a disk, cut and drilled to match the face of the flanges between which it is to be

used. It must be as thin as possible ( $\frac{1}{16}$  in. in this particular case) because it has to slip between the flanges without changes in the existing piping. To admit the thermocouple, a hole slightly larger

#### COMING DEC. 29: Water Still Controls Itself Automatically

By H. Leslie Bullock, Winner of the October Contest

##### ★ How Readers Can Win

**\$50 Prize for a Good Idea**—Until further notice the Editors of *Chemical Engineering* will award \$50 each four weeks to the author of the best short article received during that period and accepted for Plant or Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

**\$100 Annual Prize**—At the end of each year the period winners will be rejudged and the year's best awarded an additional \$100 prize.

**How to Enter Contest**—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates (\$10 min.).

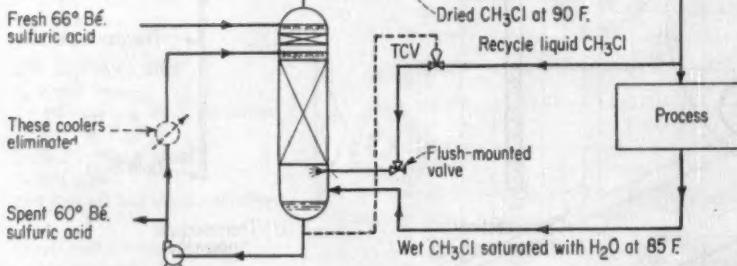
Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Design Notebooks, *Chemical Engineering*, 330 W. 42nd St., New York 36, N. Y.

than the outside diameter of the thermocouple sheath is drilled radially through the disk.

For securing the thermocouple, a 1-in. half coupling is welded at the outer end of the drilled hole to receive a Conax stainless steel packing gland. This gland has a soft sealant material which allows the

immersion depth of the thermocouple to be varied.

Installation is made by passing the thermocouple through the packing gland to the center of the disk and tightening the packing nut. The whole assembly is then ready to be placed in the jacketed process line at any flanged joint.



## Cutting Corrosion in Refrigerant Drying

Jerome A. Seiner\*

Design Div., Chemical Corps Phosphate Development Works, Sheffield, Ala.

Chemical process industries often find it convenient to dry refrigerants in sulfuric acid contacting towers. However, using this method is likely to result in a corrosion problem in cooling the weak recirculating acid.

\* Present address, Development Engineer, Springdale Research Center, Pittsburgh Plate Glass Co., Springdale, Pa.

The diagram shows a solution to this problem. This was to inject some of the recycling liquid refrigerant directly into the vapor space below the tower packing, controlling injection rate to maintain the desired weak acid temperature. A flush-mounted valve maintained flashing in the tower to produce the needed cooling.

## Get Seven Days' Records On a One-Day Chart

D. C. Williams

United Carbon Co., Aransas Pass, Texas

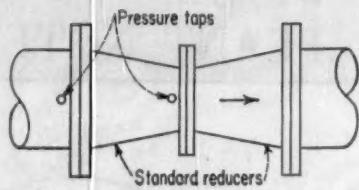
After operating a new plant for about six months we found that a seven-day chart would have been more satisfactory than the 24-hr. charts used on our reactor flow recorders. Chart cost, time for putting them on and taking them off, as well as time for processing them, would all have been reduced.

With nine reactors, each having five recording instruments, the cost of installing new electric chart drives at \$13.60 each would have come to \$612 and this would have

required several days' installation time. So we tried a simpler method.

The instrument department's recommended solution was very economical and has proven satisfactory during three years' operation. We connected the 45 instruments to a single circuit breaker and divided them into two 110-v. circuits. We bought a two-circuit on-off adjustable cycle timer for \$72 and installed it in 4 hr. We then adjusted the time current was supplied to the instrument clocks for one-seventh of the total time, i.e., for 2 min. out of each 14.

This simple and ingenious solution worked perfectly after a few minor changes in the setting made during the first few days to get the clocks functioning exactly on time.



## "Quickie" Substitute for a Venturi Meter

G. L. Head

Ammonia Dept., African Explosives & Chemical Industries, Ltd., Modderfontein Dynamite Factory, Northrand, Transvaal, S. Africa

A venturi meter is usually the primary device selected for measuring flow of slurries, since it is the type least likely to choke up.

However, a venturi is expensive and if only a rough indication of flow rate is needed, a quick and easy substitute can be made from two standard flanged pipe reducers, bolted end-to-end as shown in the sketch above.

To get the greatest possible accuracy out of this device it should be calibrated at several points in the range in which it is to be used. This is because the relationship between flow rate and pressure drop may not be a smooth curve.

## Find Gas Velocity by Ammonia Injection

R. L. Johnson

Research Chemist, Western Pine Assn., Portland, Ore.

In the March 24, 1958, issue Lyndon Babcock described a stunt he had used to determine the velocity of  $\text{SO}_2$  in a stack. He released small rubber balloons in the base of the stack and timed their trip to the atmosphere.

In some ways I believe a method I used about 15 years ago has advantages over the balloon method. The problem was to find the velocity of gases in the tail stack of an acid plant's  $\text{SO}_2$  absorbers. The solution was the instantaneous injection of a generous dose of 28% ammonia into the base of the stack to produce a voluminous white cloud at the exit. A stop watch assisted in converting the time of rise of the white cloud into velocity data.

## ● Report From Washington . . .

Six months after proposing a hike in the federal minimum salary levels for professional employees, Labor Secretary James P. Mitchell still has the matter "under consideration" on his desk.

Labor Dept. wage-hour experts say they are still sifting through reactions to the proposal coming from businessmen and labor officials since the recommendation last April to raise the level from \$75 to \$95.

A spokesman reported a "substantial number of briefs" had been filed with the department, many complaining that the proposed salary level was too low. One brief asked for automatic exemption for any engineer who has obtained a professional license.

. . . Raises This Question Anew:

## Should Your Employer Pay You Overtime?

**Robley D. Stevens, Management Consultant, Washington, D. C.**

An employer of chemical engineers should avoid assuming that an employee is either entitled to or exempted from overtime pay on the basis of his title or salary. There's much more to it than that.

In substance, the Fair Labor Standards Act states that anyone covered by the law must be paid overtime for work beyond 40 hours per week. The question is: Who in your company is covered and who is not? You can answer the question by comparing the job functions of each chemical engineer with the official simplified "tests" of duties, salary and other requirements for eligibility.

### Must Meet All Requirements

Employees are not exempted because they have impressive titles or are paid a good salary. In brief, anyone in a chemical engineering organization whose job measures up to *all* the requirements is not officially entitled to overtime; and he is exempted from the wage-hour

regulations. Here are three classifications of exemptions as made by the Dept. of Labor.

An *executive chemical engineer* is one: (a) whose primary duty is the management of the company that employs him or of a recognized department of the company; (b) who regularly directs the work of at least two fulltime employees; (c) who can hire or fire, or recommend hiring or firing or whose suggestions in connection with hiring or firing are given particular weight; (d) who regularly exercises discretionary powers; (e) who devotes more than 20% of his workweek to nonexempt work; and (f) whose salary is at least \$55/week.

For quick reference, you can use the short test given in the table on the next page.

An *administrative chemical engineer* is one: (a) whose primary duty is responsible office or non-manual field work of substantial importance to management or to

the operation of the company; (b) who customarily and regularly exercises discretion and independent judgment, as distinguished from using skills and following procedures. He must have the power to make important decisions; (c) he must spend no more than 20% of his workweek on nonexempt work, that is, work not closely related to his administrative duties; and (d) he must earn a salary of at least \$75/week.

For quick reference you can apply the short test given in the table.

### Who's a Professional?

A *professional chemical engineer* is one: (a) who consistently exercises discretion and judgment; (b) who does work that is mainly intellectual, as distinguished from routine or mechanical duties; (c) who spends no more than 20% of his workweek on activities not closely related to his professional duties; and (d) who earns at least \$75/week.

## For Quick Reference

These short tests may be used to determine which employees are exempt from wage-hour rules. For more thorough checks, see text.

### Executive Chemical Engineer

- Earns at least \$100/week.
- Regularly directs the work of at least two fulltime employees.
- Primary duty is management of company or department.

### Administrative Chemical Engineer

- Earns at least \$100/week.
- Primary duty is responsible office work or nonmanual field work of substantial importance to management.
- Work requires use of discretion and judgment.

### Professional Engineer

- Earns at least \$100/week.
- Primary duty is learned professional work requiring consistent exercise of discretion and judgment.
- Work requires invention, imagination or talent.

A short test for this category is also given in the table.

There's another important criterion for the professional, however. To be considered for the exemption as a professional, the employee's work must require advanced knowledge in a field of science or other branches of learning, usually obtained by a long course of specialized intellectual instruction at a college or university. The mere possession of a degree does not automatically exempt the worker. (EDITOR'S NOTE—*By similar reasoning, the mere possession of a professional engineer's license would not automatically exempt the worker as a professional.*)

It's equally important that you understand that the primary purpose of the exclusionary language—placing a limitation on the amount of nonexempt work—is to distinguish between the *bona fide* executive and the working supervisor who regularly performs work only remotely related to supervisory activities.

An office manager in a chemical engineering organization who does not supervise two or more other employees would not meet the requirements for exemption status as an executive employee, but may

possibly qualify for the exemption status as an administrative worker.

### No Blanket Exemptions

You can see, therefore, that the wage-hour regulations do not exempt all employees of professional employers, nor all employees in any particular occupation.

Neither do they exempt persons with professional training who are working in professional fields such as chemical engineering. The field has many persons with the title of engineer who are not professional employees, including many who are trained in the engineering profession but are actually working as trainees, junior engineers or draftsmen.

It's natural for engineers working in the chemical process industries to prefer to be classified as professional workers and a part of the management team—most of them are. But it is not enough to be considered one in title alone. Your job performance should meet all tests laid down in the wage-hour regulations for the exemption status. In short, a job title is insufficient as a yardstick for exempting any individual worker from overtime pay after he works 40 hours in any week.

Employers should also keep in mind the fact that these requirements apply only to employees who are engaged in interstate commerce or in the production occupations closely related and directly essential to such production. However, the interstate activities of most firms that employ chemical engineers bring their employees within the scope of the federal wage-hour law.

### Why Records Are Needed

Employers are required to keep certain time and payroll records, but the Dept. of Labor requires no particular form or order.

Based on past experiences, these records should be kept for inspectional purposes: employee's full name; his home address; his social security number; the occupation in which he is employed; time and day his workweek begins; total hours worked weekly; basis on which his wages are paid; legal deductions from wages paid; total wages paid each pay period; and date of payment and pay period covered by payment.

Although this list may seem long,

it's important to remember that the Dept. of Labor investigator's first contact with an employer is through an audit of the records. Inaccurate or incomplete records might prove costly.

Many chemical engineers are on a fixed working schedule. In these cases, the employer should keep a record showing the exact schedule of daily and weekly work hours that the employee is expected to follow. Obviously, records must be open for official inspection since an investigator may request your company to make extensions, recomputations or transcriptions.

### Double Damages Probable

The expanded coverage of the federal wage-hour law means that an employer of chemical engineers might subject himself to litigation, criminal actions, or wage suits brought about by employees not found to be officially exempted. When an inspector finds that back wages are due an employee, it is also a probability that double damages will be assessed against the employer.

Tips or complaints may arise from many sources—competitors, labor unions, employees and ex-employees. Aside from this, however, is the fact that a re-inspection by the Dept. of Labor may occur at any time.

Overtime is expensive enough without making it more so by misclassification of chemical engineering personnel. Each employer in the field must of necessity work out his own system of compensation, consistent with the wage-hour regulations.

Our purpose in presenting these pointers and clarifications is to remind both employee and employer alike what to consider when qualifying chemical engineers for exemption status. Both owe it to themselves to have a working knowledge of the basic requirements for exemption.

Only then will you be able to decide whether your employer should pay you overtime?

**ROBLEY D. STEVENS** is a management consultant in Washington, specializing in labor relations. He is a former official representative of the U.S. Dept. of Labor. In his spare time, Dr. Stevens collects autographs of famous people. Over 10,000 are in his collection.

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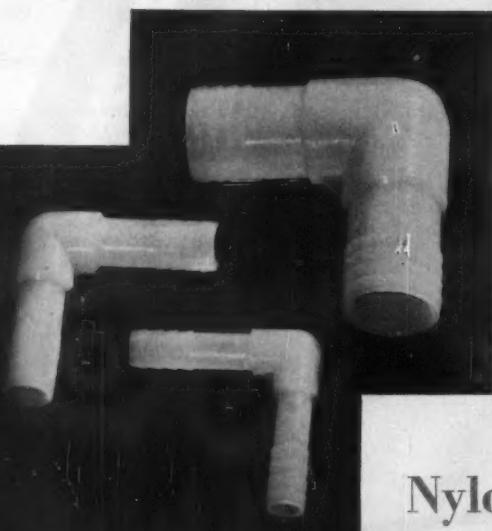
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PRACTICE...

## CORROSION FORUM

EDITED BY R. B. NORDEN



LATEST FORMS: Nylon 6 pipe and fittings are designed for handling alkalis, solvents, oils.

### Nylon 6 for Process Applications: Tougher, Stronger Than Usual Nylons

D. L. Duncan, Spencer Chemical Co., Kansas City, Mo.

**Consider this new nylon for process use. It's easily formed, will be available as pipe, tubing.**

Nylon, a familiar term to most chemical engineers, takes on new meaning with the recent introduction in the U. S. of different varieties of this polyamide.

Nylon is a generic name for a family of polyamides, the members of which have a number of traits in common, but also exhibit important differences.

The senior nylon in this country, in terms of years, is Type 66, made from two materials: hexamethylene diamine and adipic acid. Each of these raw materials has six carbon atoms in its structure—thus, the term Type 66.

The most active newcomer is Type 6 nylon, which is polymerized from caprolactam, a material having a single six carbon ring. There are, in addition, other types of nylon available such as Type 610, Type 11, and various copolymers, each of

which carries a designation based on the carbon atom arrangements.

For a number of years nylon 6 has performed well in Europe in textiles and monofilaments,—areas traditionally given to Type 66 and 610 types in the United States—as well as in engineered industrial items. It has been only during the past three years or so that nylon 6 has been produced in this country. Today, it's made by five domestic sources.

► **Why this Plastic?**—But why should you consider nylon 6 for chemical process applications? There are a number of good reasons, many based on the unique properties of this plastic.

Type 6 is a light-weight material possessing high tensile strength and much higher impact strength than the more familiar nylon types. Combined with this toughness is nylon's self-lubricating quality, resistance to elevated temperatures, wear resistance, good chemical resistance, plus exceptional ease of processing.

In general, there is excellent

#### Imposing Advantages

- Light weight
- High strength
- Temperature resistant
- Abrasion resistant
- Chemically resistant
- Easy to process

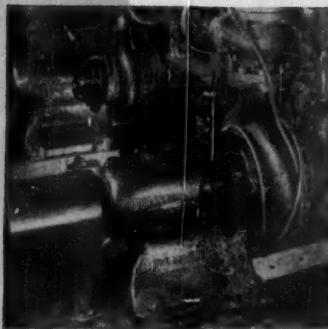
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is the word for DURCO INSTALLATIONS

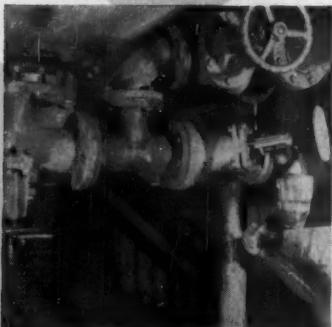


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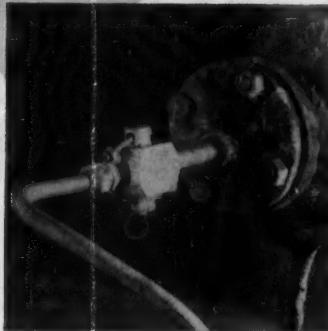
**Jones & Laughlin**  
STEEL CORPORATION - PITTSBURGH



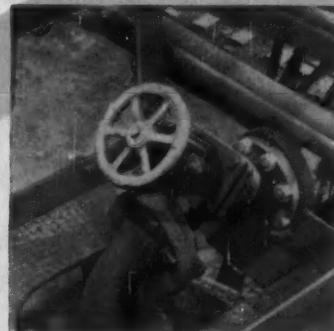
Durcopumps on tank car loading of residual tar at 200° F. These pumps handle approximately 150,000 gals. a day. Durcopumps exclusively are also used by J & L for tar distillation units with temperatures up to 600° F.



Durco Type J202 Durimet 20 Y valves handling 60° Be. sulfuric acid mixed with coke oven light oils, and neutralized by sodium hydroxide. These Durco valves replaced 316 stainless steel gate valves that leaked after six months' service. The Type J valves have now been in service for more than 1½ years with no sign of corrosion or line leakage. The atmosphere in this area is also severely corrosive.



One of the first Durco Type F valves ever built. This valve has been in continuous service since December 31, 1949, handling 5% sulfuric acid saturated with ammonium sulfate.



Durco Type J202 Durimet 20 Y valve in service on inlet of 20,000 gals. 66° Baume H<sub>2</sub>SO<sub>4</sub> storage tank. This valve replaced a 316 stainless steel gate valve.

DURCO DEPENDABILITY is the reason for these and many other DURCOPUMP and DURCO VALVE installations at the Jones & Laughlin Steel Corporation's By-Product Plant in Pittsburgh.

DURCO handles the *tough* corrosives and the *tough* services throughout the chemical process industries. The fact that DURCO equipment can be depended upon for maximum service life with minimum maintenance is the basic reason more people every day are turning to DURCO chemical process equipment. For complete details, call or write: The Duriron Company, Inc., Dayton, Ohio, or contact your nearest Durco Sales Office.



Durco Type F valves on lines from constant feed storage tank to centrifugal dryers. The tank contains 5% sulfuric acid saturated with 15-20% ammonium sulfate crystals in suspension.



Series R Durcopump with more than five years' service, and Durco Type F valve with more than three years' service handling Ammonium Sulfate solution at 105° C. "Absolute minimum of maintenance."



*The mark of dependability in tough chemical service . . . everywhere*

**THE DURIORON COMPANY, Inc., DAYTON, OHIO**

Branch Offices: Baltimore, Boston, Buffalo, Chicago, Cleveland, Dayton, Detroit, Houston, Knoxville, Los Angeles, New York, Pensacola, Fla., Philadelphia and Pittsburgh.

## Where to Use Nylon 6

## Acids

Sulfuric (30%)	Rapid attack
Nitric (10%)	Rapid attack
Hydrochloric (10%)	Rapid attack
Formic (90%)	Dissolves
Glacial acetic	Dissolves
Organic acids in low concentrations	Little or no effect

## Alkalies

Na hydroxide (10%)	No effect
Soaps	No effect
Ammonium hydroxide	No effect

## Organics

Phenols, cresols	Dissolves
Carbon tetrachloride	Little or no effect
Toluene	Little or no effect
Ethanol	Little or no effect
Lubricating oil	Little or no effect

resistance to: weak and strong alkalis; solvents such as gasoline, acetone, turpentine, kerosene, and carbon tetrachloride; petroleum oils and greases; organic acids in low concentrations; mineral oils; bleaches; and fats. Nylon 6 cannot be recommended for use with oxidizing agents, mineral acids, phenols and cresols, or organic acids above low concentrations.

Nylon 6 has a high degree of impermeability to gases such as oxygen, nitrogen, hydrogen, halocarbons, and carbon dioxide.

► **Temperature Resistant**—As for temperature resistance the range in which you can use a non-heat stabilized grade of nylon 6 is -40 to +160 F. For heat-stabilized nylon 6, the use range is -40 to +300 F.

Costwise, molded nylon can frequently effect savings over machined metal or other materials. In one application a molded nylon end plate, at a cost of approximately 85¢, replaced a machined laminate costing over \$8.

► **Easy to Form**—Due to its higher melt viscosity, nylon 6 enjoys a significant advantage in the relative ease with which it can be injection molded and extruded. Especially noteworthy are processing characteristics which permit production of molded parts having thick cross sections and, for nylon, weights which may even be called massive. On the other hand, it is far easier to produce moldings with thin cross sections and large surface areas. To the designer, this is every bit as important as it is to the man who must produce the nylon moldings, since it opens areas hitherto unattainable by nylon. We may now think of nylon parts in terms of pounds per piece instead of ounces.

Large, heavy sections weighing several pounds can be produced by centrifugal casting or extrusion molding. In these applications nylon 6 has light weight and self-lubricating properties which enable it to effectively replace other materials. In one case, a nylon 6 sector gear weighing 21 oz. attached to a light-alloy part resulted in a combined part weighing 9 lb., which replaced a cast iron part weighing over 100 lb.

Gearing, couplings, bearings, and bushings may be molded or machined from rod or slab stock. Similarly, valve seats, rollers, nozzles, packings, and back-up rings can be machined from nylon 6 rod, carried in the stock room.

Nylon valve seats, for instance, recently proved to be the answer to a problem in a plug valve used for taking samples

**D. L. DUNCAN** is manager of market development for the plastics division of Spencer Chemical. He has extensive experience in plastics. Previous to his present position he worked in sales and technical service for the Kel-F division of M. W. Kellogg, then went with Minnesota Mining and Manufacturing. Mr. Duncan is a mechanical engineer (B.S.) from NYU and a member of ASME and the Society of Plastics Engineers.

from a vacuum dryer. Abrasion had rapidly worn out both stainless steel and fluorocarbon seats but the nylon seat is still in service after several months. Sheet and slab stock can also be stocked and used for wear surfaces, doctor blades, and other items.

► **In Conveying Systems**—There are good possibilities for using nylon 6 in conveying systems—anything from a conveyor screw to plate type conveyor sections, rollers, and buckets. In one instance, a nylon 6 conveyor screw has replaced a metal alloy which needed finishing and polishing. It has the additional advantage of not scratching the glass bottles being handled and kept breakage to a minimum.

Oriented sheeting of nylon 6, now used in transmission belting, may soon be used as a reinforcement for conveyor belting, resulting in a strong, light weight belt with a minimum of stretch in service.

For electrical applications, nylon 6 is now being used as a jacketing material on type TW gasoline resistant wire (UL approved). Insulating bushings of nylon are well known as a means of eliminating galvanic corrosion.

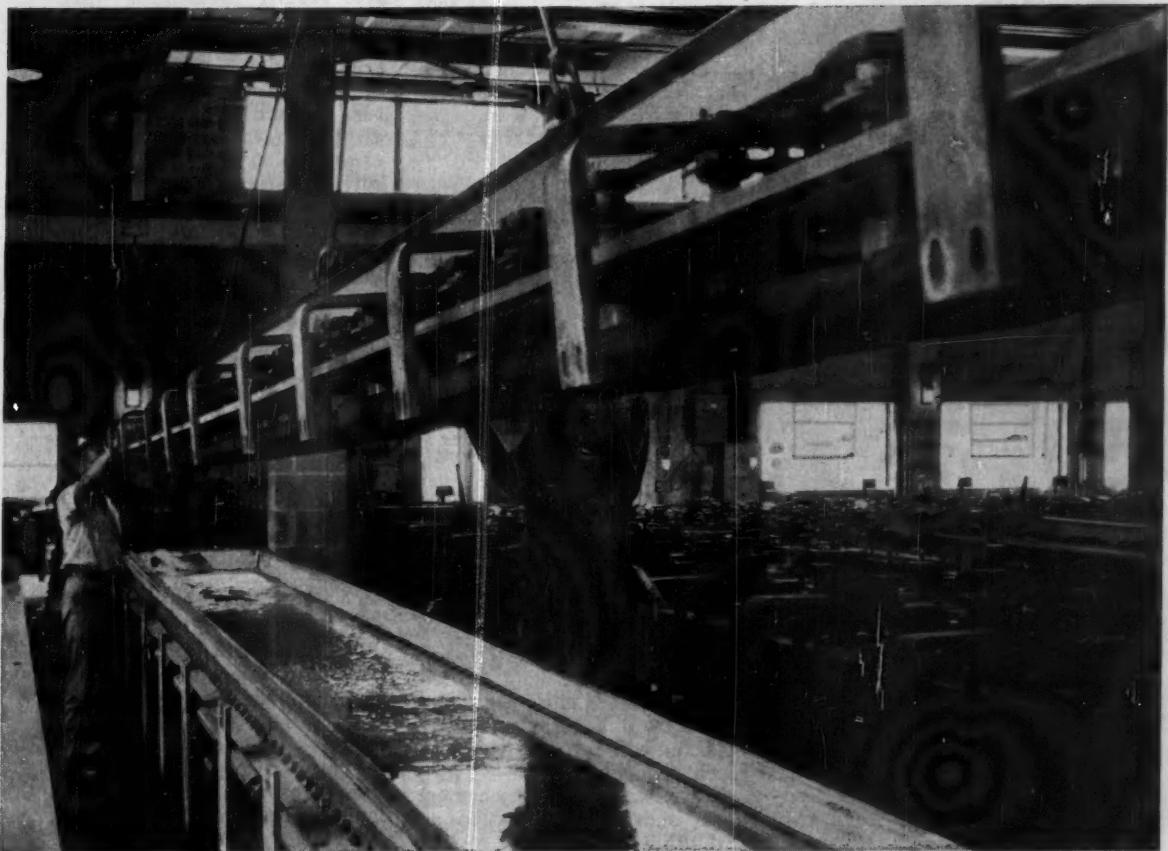
One of the most prominent new areas where nylon 6 is particularly applicable is in film. Film made of nylon 6 is almost glass clear, extremely tough, strong, and resistant to oils, greases, and solvents. Currently in the market development stage, nylon film should be in use shortly as a packaging medium for petroleum products, solvent and solvent-containing materials, and greases.

Packages may be of unsupported film, nylon coated paper, combinations of nylon and other plastics such as polyethylene; or possibly fiber drums with a grease-resistant liner of Type 6 nylon film.

► **Pipe and Fittings Coming**—Pipe and fittings of nylon 6 are just beginning to come on the American market. In this application, the strength, temperature resistance, and resistance to chemical attack make nylon 6 pipe a natural for lines handling oils, greases, alkalis, or solvents, and for lines requiring



PERMOBOND LININGS



## 252 metal cells are resistant to chlorine and chlorinated salt solutions

This plant of Olin Mathieson Chemical Corporation at McIntosh, Alabama, produces hundreds of tons of chlorine daily. Because chlorine and chlorine salt solutions destroy metal in a matter of hours, the 252 carbon steel cells used here are protected with U. S. Permobond® Linings S5471. This is a special compound of Permobond Linings that has been successfully used by producers of chlorine for the past several years to protect the metal parts in electrolytic amalgam cells. This same Permobond S5471 is the *right* lining for all chemi-

cal processors who use this highly corrosive basic chemical.

Any original equipment can be lined with Permobond before delivery. You can also have it put on existing equipment—*right in your own plant*.

United States Rubber Company maintains a field force of special sales engineers to give you the best and fastest help on your corrosion problems. Get in touch with any of our strategically located branches or write U. S. Rubber, Rockefeller Center, New York 20, N. Y.



Mechanical Goods Division

# United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y.

In Canada: Dominion Rubber Company, Ltd.

## Important Physical Properties of Nylon 6

Tensile strength, psi.....	11,700
Yield point, psi.....	11,700
Elongation, % .....	.70
Modulus of elasticity in tension, psi.....	430,000
Impact strength, Izod, ft. lb/in. notch.....	1.1
Compressive strength, psi.....	8,800
Flexural strength, psi.....	16,700
Heat distortion point at 66 psi, F.....	345
Specific gravity .....	1.14
Coeff. of linear thermal expansion, in./in. F.....	$4.6 \times 10^{-5}$
Dielectric strength (short time), v/mil.....	440
Flammability .....	Self extinguishing
Tabor abrasion (CS 17 wheel, 100g.), mg./1000 cycles.....	5.0
Rockwell hardness .....	117

\* All tests at 73 F. Specimens contained less than 0.3% moisture

### steam cleaning or sterilization.

In many cases, nylon 6 piping may replace glass or stainless steel and do a better job at less cost. Nylon fittings for pipe, hose, and tubing can be used with a variety of different pipe and tubing materials.

Tubing of Type 6 nylon is now being used for instrument air lines, and we also find nylon tubing in lubricating systems. Nylon vacuum lines and refrigerant lines should be in use shortly. The flexibility of nylon 6 tubing eliminates the need for preforming frequently required with metal tubing installations.

**► Look Out for Moisture**—In looking at the properties of nylon 6, two important features of the surrounding medium, temperature and moisture content, play a determining factor in the characteristics of any particular nylon part in service.

Increasing moisture, in terms of relative humidity, and higher temperatures result in higher impact strength but lower tensile strength. Increased humidity and temperature will also result in decreased flexural strength and less hardness. These factors must be taken into account beforehand and design based accordingly or difficulties can arise.

An additional characteristic of nylon 6 is its ability to exist

in an amorphous or crystalline state. The amorphous nylon 6 is characterized by clarity, greater softness and flexibility, higher impact strength and less wear resistance. Crystalline nylon 6, on the other hand, will be harder, stiffer, more wear resistant, will absorb less moisture, and will be optically translucent or opaque.

Gears and most mechanical parts should obviously be as crystalline as possible, while film and sight glasses should generally be amorphous.

It is not possible to create a part which will be 100% amorphous or totally crystalline, but proper control of processing conditions can result in as much as 95% crystallinity or as little as 5%, as desired.

**► What Affects Dimensions**—Dimensional stability, an important property when nylon is used in a critical application, can be affected by three factors: temperature variation, moisture absorption, and relief of stresses in the piece. The dimensions change but slightly on the order of a few thousandths of an inch or less in most cases, but the changes must be accounted for in critical applications.

Changes due to temperature variation are readily predictable from the linear coefficient of expansion of nylon 6 as shown in the table of physical properties.

**► Important Facts**—Changes due to moisture absorption are also readily predictable when a few basic facts concerning nylon 6 are considered. These are: (1) nylon 6 "as molded" is exceptionally dry with a moisture content below 0.3%; (2) in air at a normal humidity level of around 50 to 60%, it will absorb moisture gradually until it reaches an equilibrium at around 2 to 2½% moisture content; (3) totally immersed in water or an aqueous solution, nylon 6 will absorb moisture until an equilibrium of about 9% moisture content is attained; (4) linear dimensional changes in nylon 6 due to moisture absorption follow a straight line relationship.

This process is reversible. However, it must be remembered that the absorption and/or loss of moisture proceeds at a very slow rate, with a period of months required for a part to reach equilibrium in air. Thus, once in equilibrium, the dimensions will remain stable and there will not be a day-to-day variation, nor month-to-month, nor season-to-season changes of any significance.

Through moisture conditioning techniques, the nylon part can be brought rapidly to an equilibrium condition representative of the surroundings in which it will function permanently. Once there, dimensions will remain essentially stable. If not conditioned, however, a nylon part will inevitably pick up its moisture from the air and undergo a dimensional change in service.

Stress relieving may also be performed on a nylon part before installation, thereby eliminating changes due to stress relief in service.

An interesting consideration is presented when the gradual shrinkage of a nylon part in service, caused by stress relief, is exactly counterbalanced by the amount of expansion caused by moisture absorption. Unfortunately, however, there is no guarantee that these two effects will be exactly counterbalancing. But together they do have the effect of minimizing the total dimensional change of the nylon part.

**When you have a galling problem in metal-to-metal contact**

**or galling and corrosion-resistant problems**

*investigate castings made with*  
**Waukesha**  
**metal 23\* or 88\***

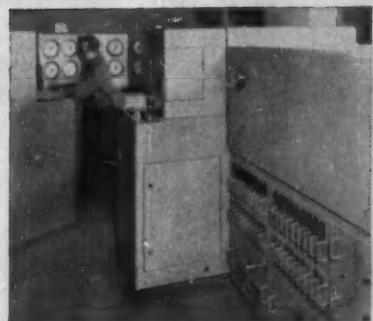
Perhaps you've tried heat treating 400 Series stainless steel alloys to solve your galling difficulties . . . and found the metal has become so hard it can't be machined. Or perhaps serious distortion occurs.

Perhaps you've tried various other alloys and found they don't measure up for *every* performance requirement . . . Either non-galling characteristics or high corrosion resistance are difficult problems separately. Combined they are an impressive engineering headache.

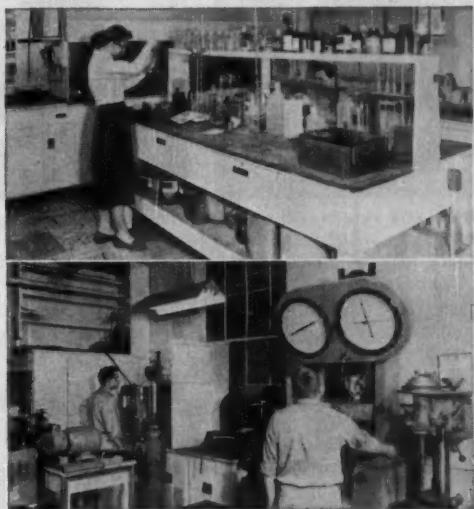
But WAUKESHA Metal 23 or 88 provides non-galling performance even under high speed metal-to-metal contact AND both are highly corrosive-resistant. Both are remarkably free-machining, without hard or soft spots. Both are homogeneous in texture.

WAUKESHA 23 and 88 have solved many of the most difficult casting problems in a great range of industries. We're glad to supply you with a list.

Or better still, write us. Describe your problems and the conditions which must be met. More than likely we'll have the answer for you.



A spectrometer checks every heat. Changes can be made before metal is poured.



Two views of the Waukesha Metallurgical Laboratory — one of the most complete in the country.



So unusual and different are WAUKESHA Metals 23 and 88 that patents have been granted on both formulations.

Waukesha Plant

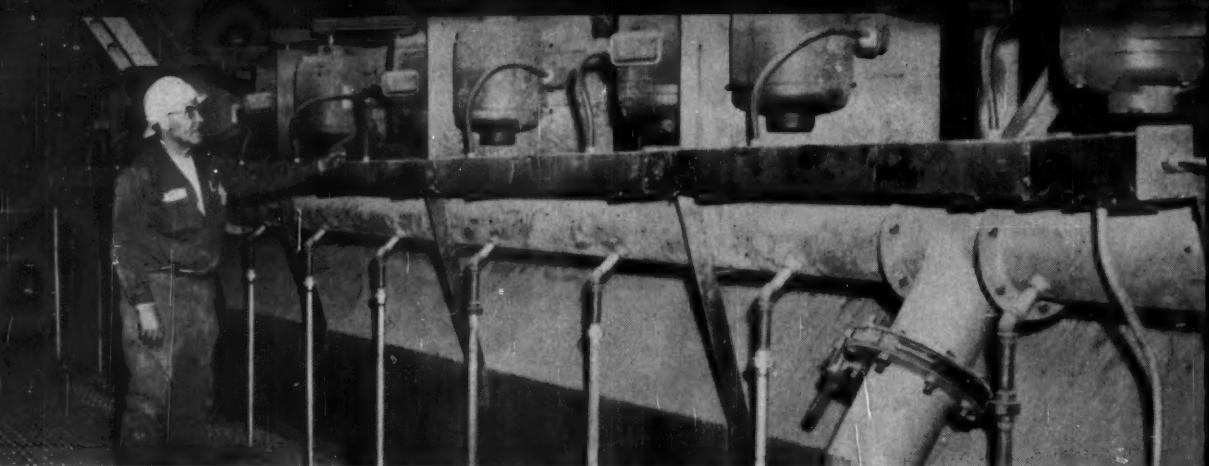


Watertown (Wis.) Plant

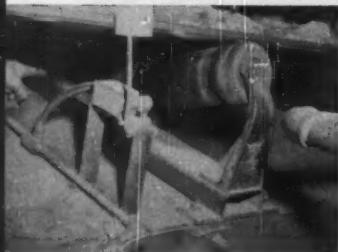


**Waukesha**  
**FOUNDRY COMPANY**

DEPT. 5805, WAUKESHA, WISCONSIN



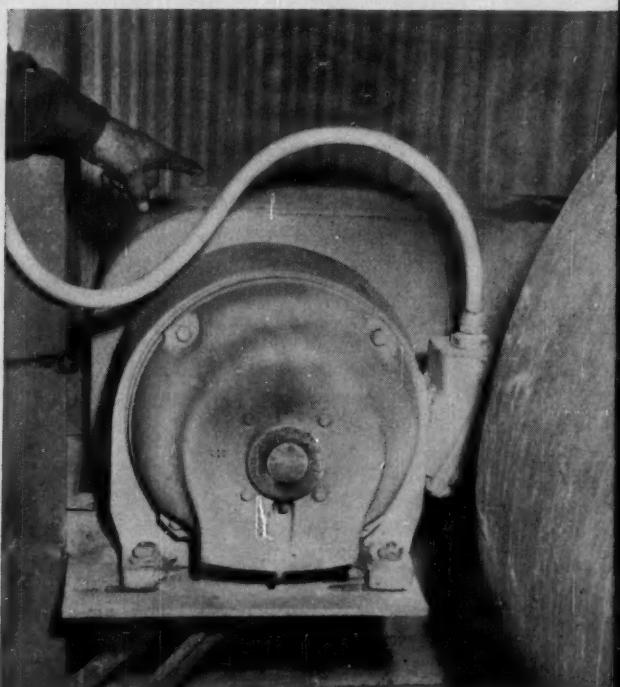
FLOTATION CELL motor connections with the raceway are protected from vibration and splash by  $\frac{1}{2}$ -inch Sealite conduit.



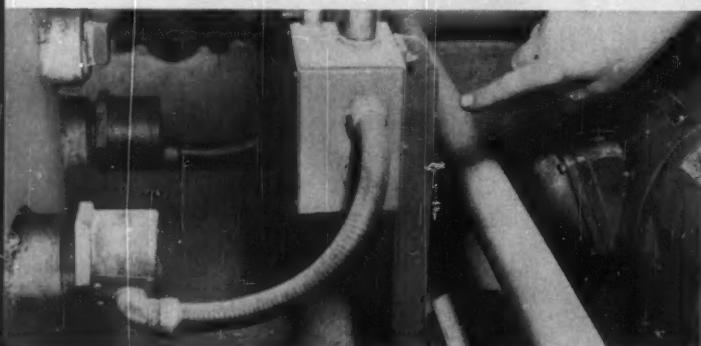
CONVEYOR side-travel switch connections are protected from spilling rock by  $\frac{1}{2}$ -inch Sealite.



OIL PUMP motor connections to conduit are protected from seeping oil by  $\frac{1}{2}$ -inch Sealite.



STORK CRUSHER exhaust fan motor connection in  $\frac{3}{4}$ -inch Sealite must accommodate motor position shifts.



IMMERSION HEATER connections for Stork crusher gyratory lube oil system are protected from heat and spillage by 1-inch Sealite.

## Nearly a mile of Sealite flexible, liquid-tight conduit protects wiring for Climax Molybdenum\*

In hundreds of vital spots, more than 4000 feet of Sealite help keep equipment operating dependably at The Climax Molybdenum Company mine, Climax, Colo. The flexible, liquid-tight conduit guards wiring to motors and controls from the full range of underground mining and mineral dressing hazards—from rock fragments to flotation reagents, dust, oil, heat, moisture, vibration, and movement.

Electrical Wholesalers stock Sealite. Buy it in long, random

lengths on nonreturnable wooden reels, at no extra cost. Available in sturdy cartons that are easy to store and carry to the job. Liquid-tight connectors also are available from wholesalers' stocks. For information write: The American Brass Company, American Metal Hose Division, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

\*A Division of American Metal Climax, Inc.



CUTAWAY SECTION of Type U.A. Sealite shows tough polyvinyl jacket over flexible metal core. Copper conductor wound spirally inside conduit gives positive ground.

insist on  
the conduit marked

**SEALTITE®**

FLEXIBLE, LIQUID-TIGHT CONDUIT

an **ANACONDA®** product

## FIRMS IN THE NEWS

R. A. LABINE

### NEW FACILITIES

#### December's Top Projects:

**Fluor Corp.** won out over several companies in its bid to erect the new helium extraction plant for U. S. Bureau of Mines at Keyes, Okla., natural gas field. Plant, to be completed by August 1959, will add 240,000 Mcf. annually to Bumine's present 360,000 Mcf. helium output.

**Du Pont** plans a 50-million-lb./yr. caprolactam plant for Beaumont, Tex., area. Plant will reportedly employ new low-cost process based on cyclohexane and "technological improvements" stemming from Du Pont research. Startup is slated for third quarter of 1960.

**Dow** has completed a 100% expansion of its polyethylene facilities at Freeport, Tex., and announces that it will finish another expansion "of major proportions" in July 1960.

**Bunker Hill Co.** intends to build a \$10-million phosphate fertilizer plant in the Northwest that will be producing by July 1960. Plant will use by product sulfuric acid from firm's lead and zinc reduction plants at Kellogg, Idaho.

**Monsanto** recently completed a 25% expansion at its Seattle, Wash., plant for making vanillin from lignin—a byproduct of wood pulping. This is the third expansion of company's vanillin production since 1955 when Monsanto transferred vanillin operations to the Seattle plant.

**Reichhold** has engineering under way for a \$4-5 million phenol plant at Tacoma, Wash. Plant's 60-million-lb./yr. output will supplement firm's existing plant in Tuscaloosa, Ala., with 70-million-lb./yr. capacity.

**Stepan Chemical Co.** is now producing p-tert-butylphenol at its new Milldale, Ill., plant. Major outlet for product will be in coatings field where it can be converted to a phenol-formaldehyde resin.

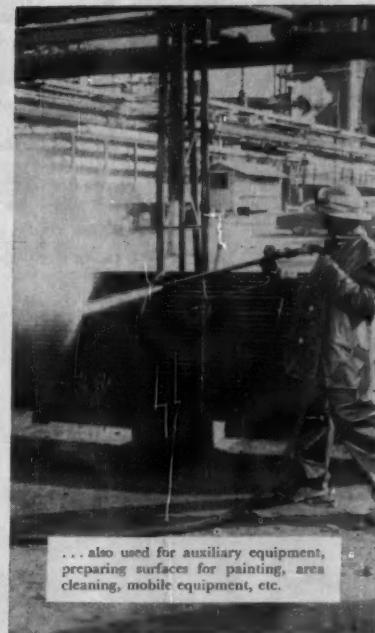
**Hooker Chemical** announces it is "substantially expanding"

di-calcium phosphate production at Columbia, Tenn. Enlarged facilities are expected to be in operation by April 1, 1959.

**Kendall Co.** has officially dedicated its new Polyken polyethylene plastic tape plant at Franklin, Ky. Principal products manufactured are plastic protective tape coatings used for corrosion prevention on pipelines, and pressure-sensitive industrial tapes.

**Fiber Industries**, jointly owned by Celanese and Imperial Chemical Industries (Britain), has selected a 215-acre tract near Shelby, N. C., for its new Teron polyester fiber plant. Construction on first plant units will start around first of the year. Eventual capacity will be 40 million lb./yr.

**Carborundum** has launched a million-dollar expansion and



... also used for auxiliary equipment, preparing surfaces for painting, area cleaning, mobile equipment, etc.

#### MOST POWERFUL CLEANING TOOL

#### Sellers hydraulic jet cleaner saves time, money, manpower!

##### Gives one man jet action!

Why tackle tough cleaning jobs the hard, slow, costly way—with many men, low-pressure equipment? Just let one man cut loose with a Sellers Hydraulic Jet! You get jet action results... cleaner heavy-duty cleaning than with any other cleaning tool regardless of price, and in far less time.

Why? Because a Sellers Jet Cleaner uses plant steam and water. Jets a hydraulic "soak" that knocks off corrosive scale, carbon, chemicals and grimes—pronto. Here's jet cleaning action that ricochets into tight inaccessible places without need to dismantle apparatus. Detergents, when required, can be metered, too. More savings!

Turn a Sellers jet on cleaning costs now. Write today for your copy of Bulletin 424B for complete details on a Sellers for all industrial uses!

**SELLERS INJECTOR CORPORATION**  
1600T Hamilton St., Phila. 30, Pa.—Since 1848

Please send me Bulletin 424B describing Sellers complete line of Hydraulic Cleaning Equipment.  
 Please send me Bulletin 435 with full information on the Sellers Jumbo Tank Cleaner.

Name \_\_\_\_\_

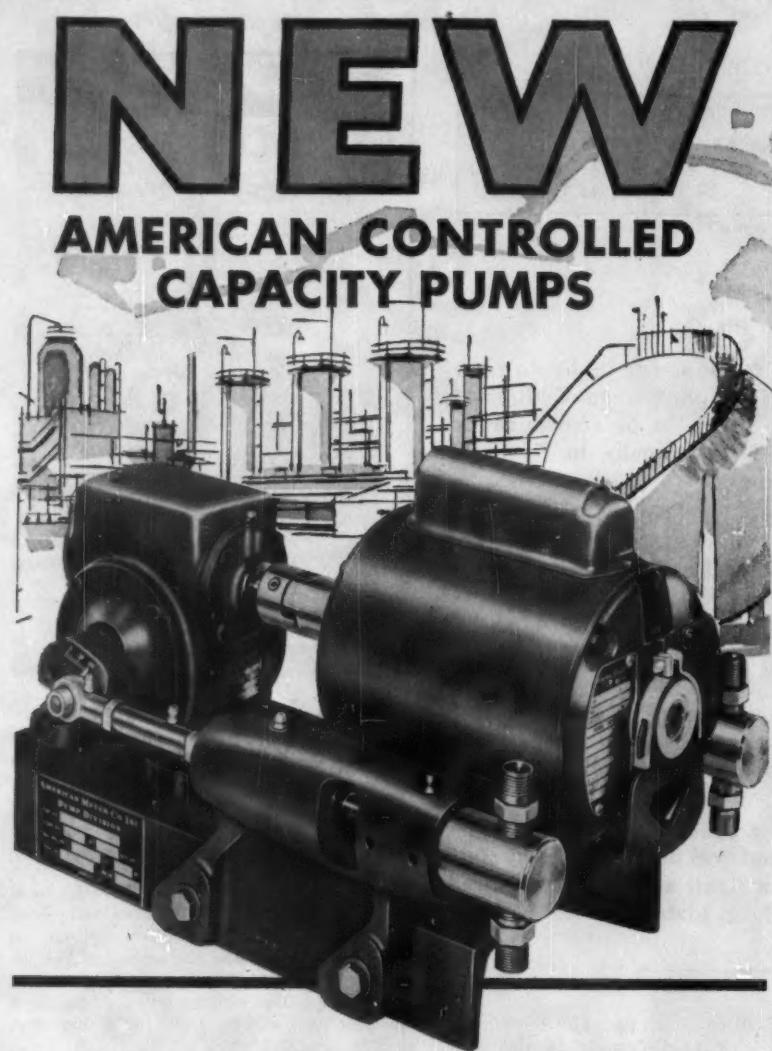
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## JOB ENGINEERED FOR LONG-TERM ACCURACY AND LOWEST MAINTENANCE COSTS

New American controlled capacity pumps are precision built to meet the needs of Chemical Processing, Refining and Boiler Feed applications. Quality construction assures highest accuracy in feeding precisely metered fluids or slurries into low or high pressure systems in virtually all desired ratios, with flow, temperature, pressure, conductivity, PH and other controlled process variables. Control may be manual or automatic—with electric, hydraulic or pneumatic systems.

Newly designed models are available to handle a wide variety of "tough," corrosive and viscous materials.

Write today for full information on American's new controlled capacity pumps. They're sure to meet your fluid proportioning requirements.

"Ask for Catalog 100"



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High Pressure Pumps • Controlled Capacity Pumps • Chemical Feed Systems  
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### FIRMS . . .

modernization program at its Keasbey, N. J., Refractories Div. plant. Initial plans call for several new buildings, re-aligning production facilities and installing new equipment; among new facilities will be a novel 225-ft. tunnel kiln.



Jones & Laughlin has started production at its new \$17-million stainless steel sheet and strip plant seven miles east of Canton, Ohio, giving petroleum and chemical industries a new source of supply. Above, operator changes a work roll on a 52-in. Sandzimir rolling mill.

Geotechnical Corp., maker of electromechanical instrumentation, has expanded into a new 40,000-sq.-ft. plant near Dallas, Tex. Move expands research and design facilities as well as production potential.

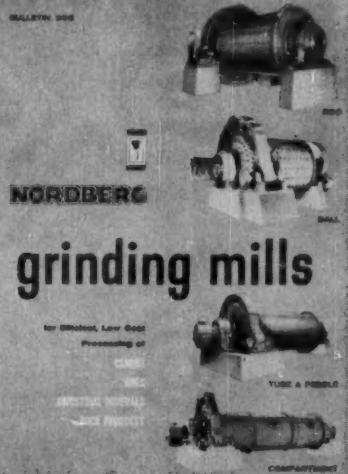
Fluor Corp. has landed a \$500,000 contract to alter and expand the Eunice, La., natural gasoline extraction plant owned jointly by Runnels Gas Products and Texas Gas Exploration. When completed in April 1959, plant will process an additional 69 million cu. ft./day natural gas.

Food Machinery & Chemical Corp. is licensing its continuous carbon bisulfide process (based on natural gas) to Snia Viscosa which is building Europe's largest CS<sub>2</sub> plant

# NORDBERG MACHINERY

## to give you greater productivity at lower cost

### NORDBERG GRINDING MILLS



BULLETIN 232 describes the complete line of Nordberg Rod, Ball, Tube, Pebble and Compartment Grinding Mills built to meet specified conditions for wet or dry grinding in practically any process where friable material must be comminuted to fine sizes.

### SYMONS VIBRATING SCREENS



BULLETIN 265 describes the design and application of one of the many types of Symons Vibrating Screens and Grizzlies designed and built to meet requirements for positive screening with large capacity of accurately sized products . . . from primary scalping to extremely fine sizing.



BULLETIN 247 describes the various types of Symons Cone Crushers used in primary and secondary fine reduction crushing of ores and minerals. Leading producers have found these efficient crushers to be without equal in producing large tonnages at low cost.

### SYMONS® CONE CRUSHERS



BULLETIN 245 describes some of the typical Nordberg engines used for efficient, low cost power generation. Built in sizes to over 11,000 hp, Nordberg engines are available in two and four-cycle, in-line and "V" types . . . for Diesel, Duafuel® and Spark-Ignition Gas operation.

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CF158

- GRINDING MILL BULLETIN 232
- CRUSHER BULLETIN 247
- SCREEN BULLETIN 265
- ENGINE BULLETIN 245

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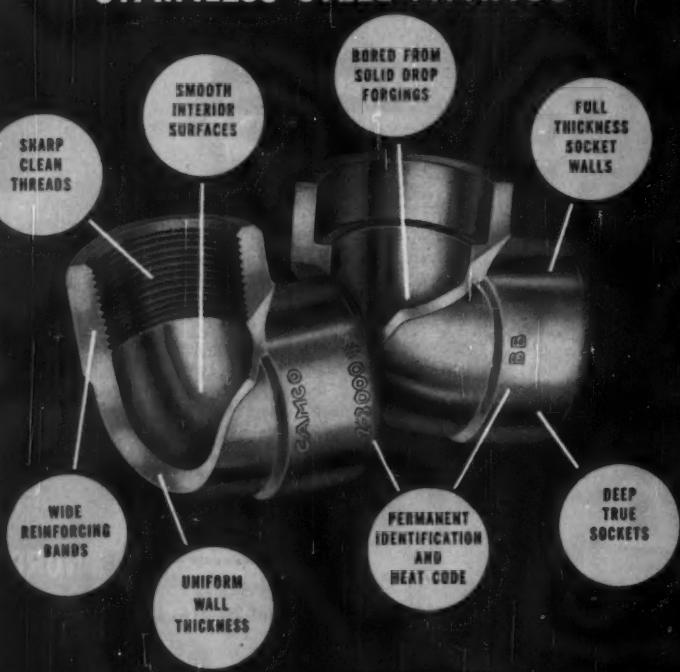
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**SPECIFY**  
**CAMCO**  
 THE *Quality Line*  
 IN FITTINGS

2000 Lb., 3000 Lb. and 6000 Lb.  
 SCREWED and SOCKET WELD  
 STAINLESS STEEL FITTINGS



Special non-standard fittings furnished to order . . . One source for all your stainless fitting requirements.

Also available—150 lb. screwed fittings and all schedules of butt-weld fittings.

CAMCO FITTINGS, INC., 301 State Street  
 North Haven, Conn.

Catalog Extra Heavy 657.  
 Catalogs covering complete line.  
 Furnish address of area distributor.

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*The Quality Line*  
 IN FITTINGS



No. Haven, Conn.

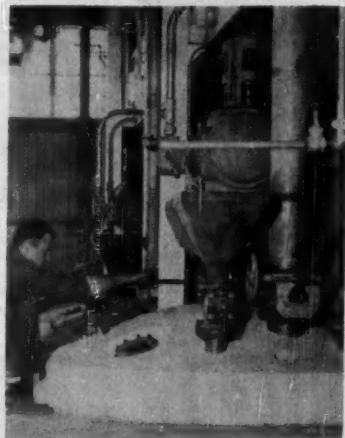
WEST COAST AGENT  
 AND WAREHOUSE

J. J. GATELEY CO.  
 8283 Baldwin Street  
 Oakland 21, California

FIRMS . . .

near Milan, Italy. Completion is expected in 1960, with major portion of output to go to rayon industry. Process is used in FMC's South Charleston, W. Va., plant.

James B. Clow & Sons opened a new \$6.5-million plant at Bensenville, Ill., for making cast iron pipe by centrifugal casting. Plant is first of its type in the Chicago area.

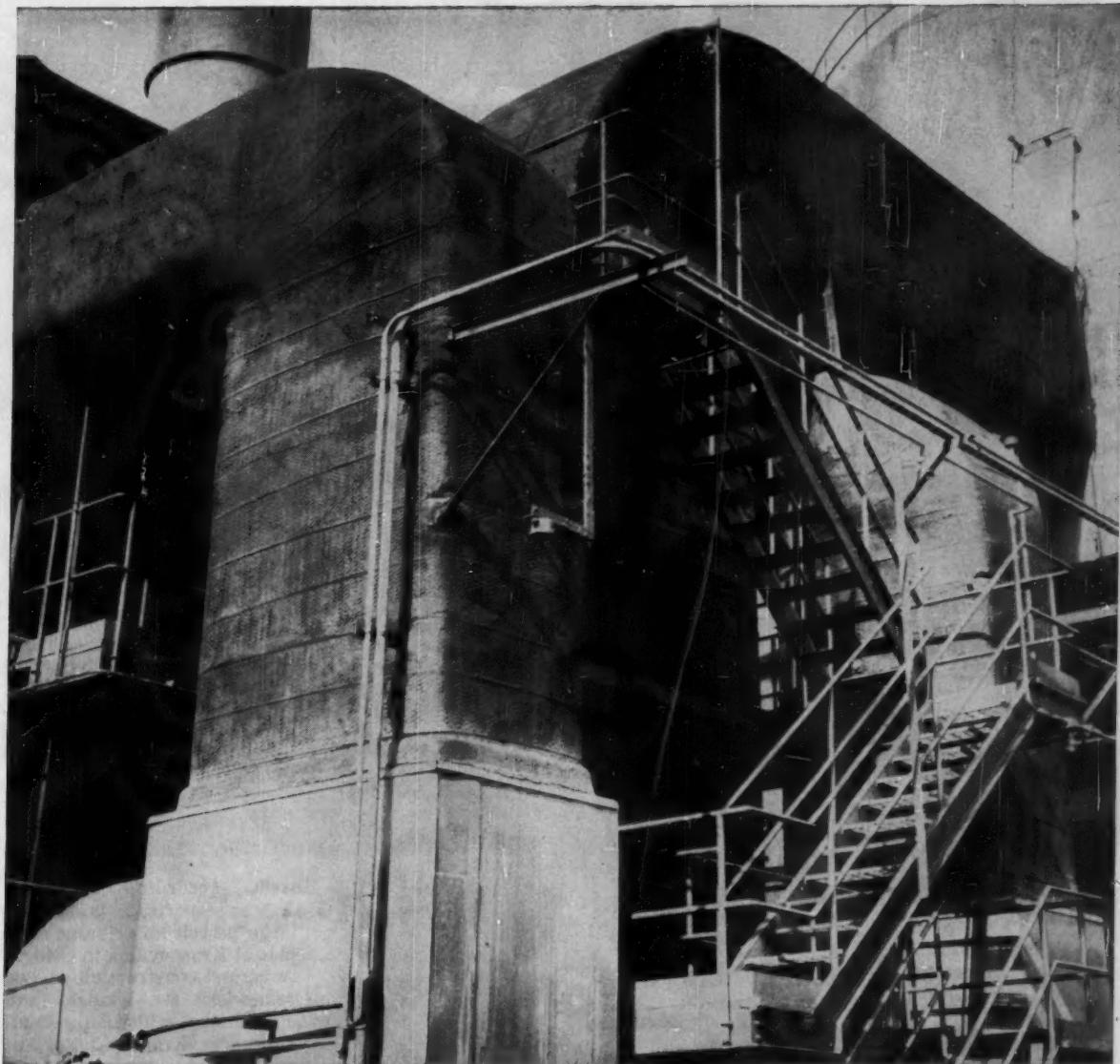


United Wallpaper has opened its third resin and chemical plant, this one in Chicago Heights, Ill. Main products will be varnishes and lacquers. Operator above makes adjustment on one of two 2,000-gal. stainless steel reactors.

National Adhesives (Canada) Ltd. is building a vinyl emulsion polymerization plant in Toronto that will provide 5 million lb./yr. emulsion capacity, expandable to 8 million lb. Plant, to be on stream in early 1959, will make polymers and copolymers for such products as paints and adhesives.

Commercial Solvents Corp. announces opening of two bulk storage facilities for 2-nitro-propane at Newark, N. J., and Los Angeles, Calif. Move was required by increased demand for this solvent in making such resins as vinyls and epoxies.

Pacific Glue Mfg. Co., Seattle, Wash., will build a second plant—serving the Portland-



**Corrosive atmosphere** of humid salt air makes great demands on such exposed items as insulation netting. South-

ern chemical producer solves the problem by using Monel hex netting as on this magnesium chloride shelf drier.

## Insulation stays up with Monel netting

Hexagon netting of Monel\* nickel-copper alloy stays up in spite of corrosive vapors, moisture, acids,

alkalies and heat that cause other materials to fail.

**And just take a closer look at the photo . . .** notice how the pliability of ductile Monel alloy helps it fit snug around insulation? It's strong as structural steel! This close-fitting support prevents flaking and peel-off . . . keeps insulation in service longer.

**Here's proof of performance:** insulation put up with Monel alloy netting



has now been in service for over 12 years. Many plants show cuts of up to 50% in annual cost of maintaining insulation, by using Monel.

**Next time you insulate,** use Monel hexagon netting — available from Gilbert & Bennett, Georgetown, Conn. They'll be glad to fill in all details . . . supply you with samples and prices.

\*Registered trademark  
**THE INTERNATIONAL NICKEL COMPANY, INC.**  
67 Wall Street  New York 5, N. Y.

# INCO NICKEL ALLOYS

# LEE

*Corrosion-Resistant*

## PROCESSING EQUIPMENT

PRECISION BUILT OF STAINLESS STEEL  
TO YOUR SPECIFIC REQUIREMENTS



Style A  
Two-thirds Jacketed  
5 to 500 gal.



Style B  
Full Jacketed  
10 to 300 gal.



Style C  
Two-thirds Jacketed  
5 to 100 gal.



Pressure Kettle  
Two-thirds Jacketed  
40 to 200 gal.



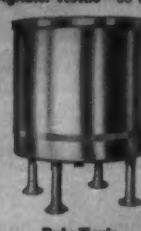
CW3T  
Counter-Line Scraper  
Agitator Kettle—30 to 300 gal.



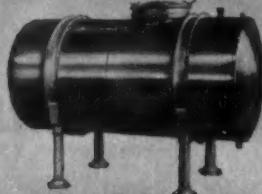
Vacuum Pan  
50 to 500 gal.



Style CW  
Two-thirds Jacketed  
80 to 300 gal.



Pulp Tank  
500 to 2,000 gal.



Storage Tank  
100 to 5,000 gal.



Quick Cooling Pan  
50 to 200 gal.

LEE

METAL PRODUCTS CO., INC.

417 PINE STREET, PHILIPSBURG, PA.

Designers and Manufacturers of  
Corrosion-Resistant Processing Equipment  
for over 25 years.

Technical bulletins  
fully describing  
these processing units  
gladly sent on request.

### FIRMS . . .

Vancouver area—to produce industrial adhesives for the paper industry. Plant cost: around \$50,000.

British Celanese's Spordon, Derby, plant is being expanded by 40%; plant makes ethylene and propylene and a wide range of petrochemicals from those two raw materials. Plant uses a cracking process developed by company engineers.

Monsanto is laying groundwork for a possible 75% future expansion of its agricultural chemicals research with its new Agricultural Research Laboratory at firm's main headquarters in suburban St. Louis. Two-story structure provides 25,000 sq. ft. for its research staff.

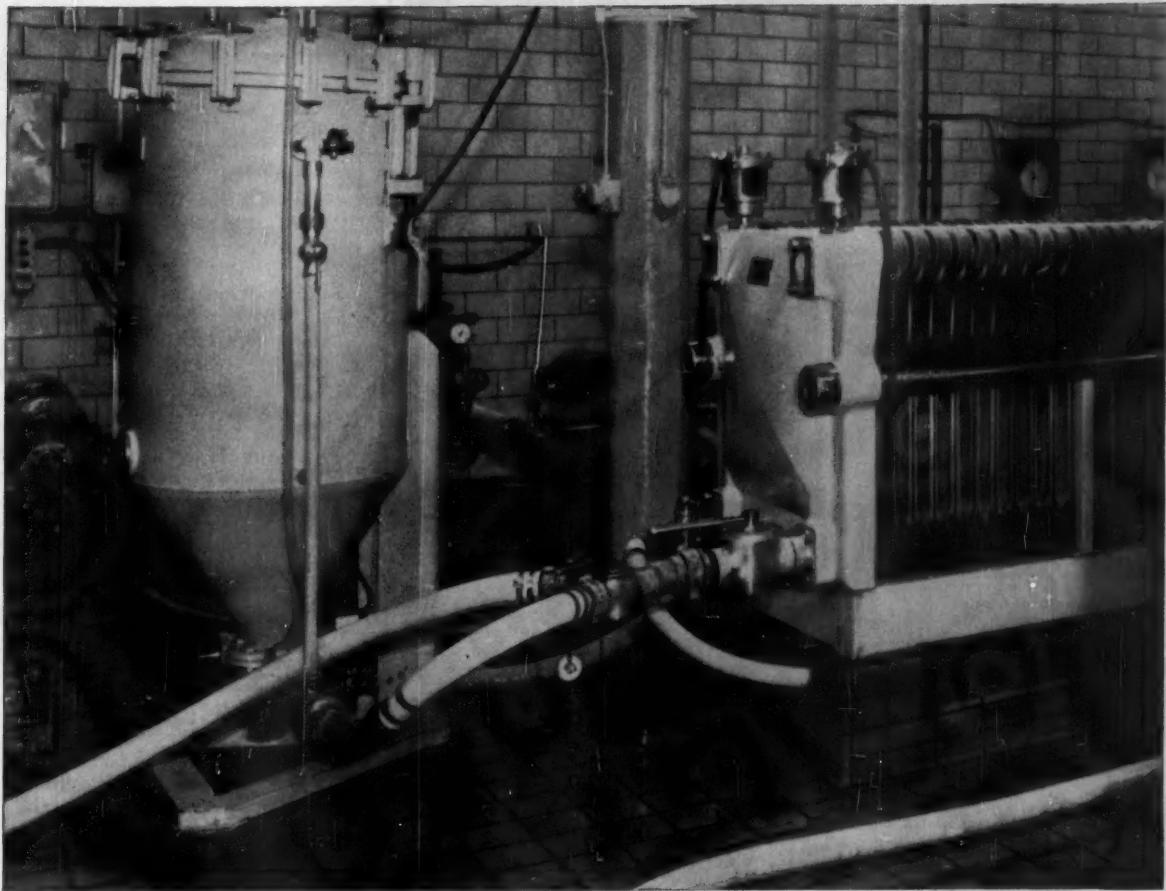
Air Reduction Co. has added a two-story polymer laboratory to its Murray Hill, N. J., research center. Research in the \$500,000 structure will be aimed at developing polymers for paints, adhesives, plastics, films and treating agents.

Russia, according to Tass Agency reports, is building a large petroleum refining complex at Krasnoyarsk in Central Asia, and construction on two refineries at Irkutsk and Transbaikal will soon get under way. Krasnoyarsk plant will supply internal needs while the Irkutsk plant will also produce refined products for Mongolia and China.

### MERGERS & ACQUISITIONS

A. O. Smith Corp. has purchased Erie Meter Systems, Inc., Erie, Pa., for an undisclosed amount of cash. Erie has been manufacturing pumps for petroleum products for 30 yr.

DuBois Co., Cincinnati, Ohio, manufacturer and distributor of soap and detergents, is sell-



## Where There's R/M ENGINEERED HOSE

*for Your*  
**There's "More Use per Dollar"**

R/M makes long-lasting rubber hose for every application in the chemical industry. For general air and water service, Homoflex is light, strong, and flexible as a rope . . . reduces cost through easy handling and long life. Special constructions are available for acids, chlorine, solvents, oil and contaminating chemicals. Condor Acid Hose, for example, can handle practically all inorganic acids and salts up to 150° F.

Special burst-resisting types with flexible wire for high pressure air and steam provide longer, safer

service. If you have corrosion, wear, or expansion problems with metal pipe installations, Condor Flexible Rubber Pipe outlasts iron or steel . . . is easier, more economical to install. R/M also makes Teflon\*-lined rubber hose for complete resistance to most active corrosive and contaminating solutions.

Ask your R/M representative to tell you about other rubber hose constructions for your specific operations. He'll show you how R/M engineered hose will do a better job, longer . . . give you "More Use per Dollar" on every job.

\*A DuPont trademark.

R/M 33

**BELTS • HOSE • ROLL COVERINGS • TANK LININGS • INDUSTRIAL RUBBER SPECIALTIES**

**MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY**

**RAYBESTOS-MANHATTAN, INC.**

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls



**D**ARLING gate valves, employing the principle shown in the cutaway above, offer a prolonged bonus in positive closure, freedom from trouble and long life. Such features as uniform wear distribution, elimination of disc-to-seat galling and compensated seating just naturally mean less maintenance, less down time, less expense through the years!

These trouble-free Darling gate valves are offered in sizes, types and metals for all kinds of normal or unusual services. Write for new Catalog No. 57.

**ENGINEERING SERVICE:** Darling offers unusual facilities for the development and manufacture of special valves for out-of-the-ordinary requirements. This special service is available to you at all times, without obligation.

#### **DARLING VALVE & MANUFACTURING CO.**

Williamsport 3, Pa.

Manufactured in Canada by  
Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.



#### **FIRMS . . .**

ing a half interest in its business to Hall-Scott, Inc., Berkeley, Calif. Acquisition is expected to be the basis for Hall-Scott's planned expansion into the chemical industry.

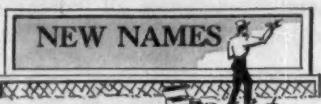
**J. F. Pritchard** and Dover Mfg. Co., both cooling tower manufacturers, have merged. Composite company, operating under the Pritchard of California name, offers a range of cooling towers with capacities ranging from a few gallons per minute to towers capable of servicing entire chemical plants.



#### **NEW LINES**

**Purolator Products**, manufacturer of automotive filters, plans to expand into industrial filtration for nuclear power, aircraft and missiles, and various process industries. Company has formed a special engineering group to develop new filters and filtration principles.

**Connecticut Instrument Corp.** announces a new ultrasonic machining service for hard and brittle materials previously considered not machinable, such as glass, ceramics, quartz and carbide. Firm says that holes and cavities of nearly any shape can be produced with a high degree of precision via ultrasonic machining.



**Glidden Co.'s Southern Chemical Div.** has been renamed **Organic Chemical Div.** indicating that firm's interest in new organic chemicals developments.

**Union Carbide** has changed the name of its Bakelite Co. to

Union Carbide Plastics Co. Company will continue to manufacture and market its regular line of Bakelite products.



**Mason Products**, manufacturer of water cooling towers, has moved from West Concord, Mass., to a new plant at 9 Cranes Court, Woburn, Mass.

**Union Carbide Chemicals** announces relocation of two of its district offices. New addresses: Buffalo District Office—4446 Main St., Buffalo 26, N. Y.; Atlanta District Office—1371 Peachtree St. N. E., Atlanta 9, Ga.

**De Laval Separator Co.** is moving its Chicago headquarters to a new \$1-million building at 5724 N. Pulaski Rd., Chicago, Ill.

**Bailey Meter Co.**, Cleveland, Ohio, has relocated its New York sales offices to 150 E. 43rd St., New York 17, N. Y.



**Delta Tank Mfg. Co.** has established a new division—Field Erection Div.—to assemble and erect products of its Pressure Vessel Div. at customer refineries and petrochemical plants.

**Constock-Pritchard Liquefaction Corp.**, with headquarters in New York City, has been formed by J. F. Pritchard & Co., Continental Oil Co. and Union Stock Yard & Transit Co. Company will develop the design and construction of plants and facilities for all phases of gas liquefaction.



## AVONDALE

**designs and builds barges**

**of every type**

**and specification**

Avondale designed, constructed and delivered two barges 195' x 35' x 11' for the transportation of chlorine in bulk in 90 days. Write for our illustrated brochure, *Marine Construction, Vol. 2*.



**AVONDALE**

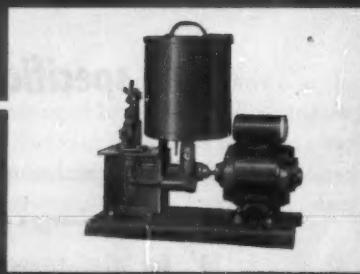
MARINE WAYS, INC.

VERSATILE BUILDER  
ON THE MISSISSIPPI

P. O. BOX 1030 • PHONE UNG-4561 • NEW ORLEANS 8, U. S. A.

**assures precision  
metering!**

**CHEMICAL FEEDERS** by Manzel give accurate, dependable metering of chemicals, acids, oils, and many other liquids. Rugged, trouble-free units are available in large or small capacities, with single or multi feeds, for any type of drive. Delivery from one cc/min/feed to one gal/min/feed, against pressures to 5000 psi. Consult your Manzel field engineer for full details and recommendations.



WRITE FOR FREE COPY of new Chemical Feeder Catalog. Detailed information permits you to select the right feeder for any job.



**Manzel**

324 Delaware Street Buffalo 10, New York

Specialists in metering pumps and lubricators since 1870



**CALENDAR**

**American Society of Mechanical Engineers**, 23rd National Power Conference, Coliseum, Dec. 1-5 New York, N. Y.

**Asphalt Institute**, annual membership meeting, Shoreham Hotel, Dec. 2-4 Washington, D. C.

**American Ceramics Society**, New York Section, dinner meeting, topic: Application of Ceramics in Rockets and Missiles, 43rd Street Bras Rail, Dec. 3 New York, N. Y.

**American Society of Mining, Metallurgical and Petroleum Engineers**, 16th Electric Furnace Conference, Statler Hotel, Dec. 3-5 New York, N. Y.

**American Petroleum Institute**, Oil Information Committee, Waldorf-Astoria Hotel, Dec. 3-5 New York, N. Y.

**American Society for Engineering Education**, Middle Atlantic Section, fall meeting, City College, Dec. 6 New York, N. Y.

**The Material Handling Institute**, annual meeting, Roosevelt Hotel, Dec. 7-9 New York, N. Y.

**American Institute of Chemical Engineers**, 51st annual meeting, Netherland Plaza Hotel, Dec. 7-10 Cincinnati, Ohio

**American Nuclear Society**, annual meeting, Sheraton-Cadillac Hotel, Dec. 8-10 Detroit, Mich.

**Society of Chemical Industry**, Chemical Engineering Group, Topic: Radiation-Induced Chemical Processes, 14 Belgrave Square, Dec. 9 London, S. W. 1, Eng.

**Chemical Specialties Manufacturers Assn.**, 45th annual meeting, Commodore Hotel, Dec. 9-11 New York, N. Y.

**Spectroscopy Society of Pittsburgh**, monthly meeting, Mellon Institute of Industrial Research, Dec. 17 Pittsburgh, Pa.

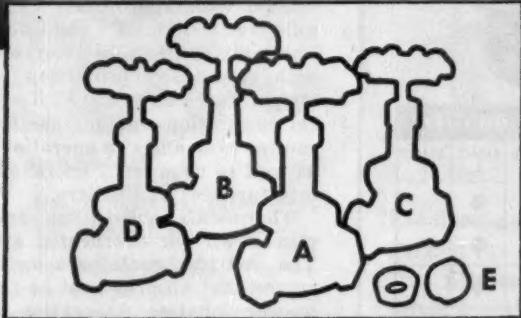
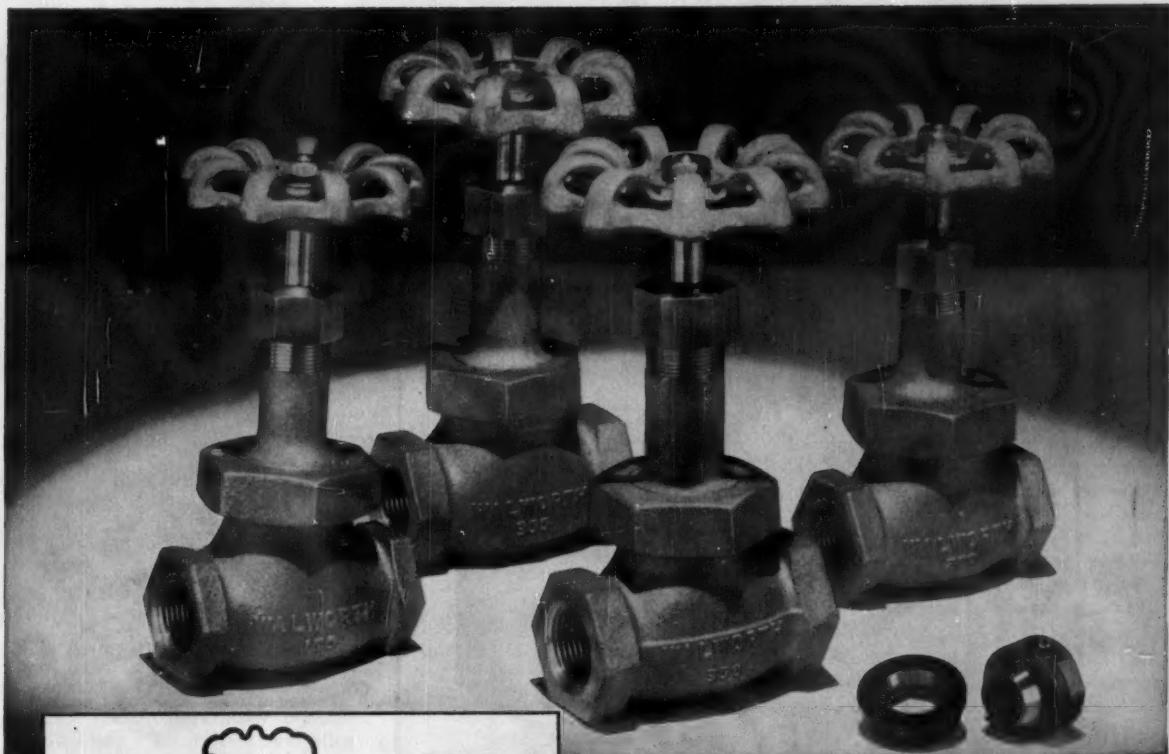
**American Assn. for the Advancement of Science**, annual meeting, Hotel Statler, Dec. 29-30 Washington, D. C.

**American Institute of Chemical Engineers**, North Jersey Section, Topic: Oil and Chemicals from Sasol Process, Shulton Lab, Jan. 6 Clifton, N. J.

**Spectroscopy Society of Pittsburgh**, monthly meeting, Mellon Institute of Industrial Research, Jan. 21 Pittsburgh, Pa.

**Plant Maintenance & Engineering Show**, Public Auditorium, Jan. 26-29 Cleveland, Ohio

**First International Symposium on Nuclear Fuel Elements**, jointly sponsored by Columbia University and Sylvania-Corning Nuclear Corp., Columbia University, Jan. 28-29 New York, N. Y.



**A** — No. 225P.....350 WSP 550F, 1000 WOG  
**B** — No. 260P.....300 WSP 550F, 600 WOG  
**C** — No. 245P.....200 WSP 550F, 400 WOG  
**D** — No. 237P.....150 WSP 500F, 300 WOG  
**E** — "500 Brinell" Stainless Steel Plug Type Seat and Disc

Walworth offers four lines of Bronze Globe Valves with stainless steel, plug-type seats and discs. Advantages of these valves include:

- **Stainless Steel Plug-Type Seats and Discs**, heat-treated to a hardness of 500 Brinell reduces wire-drawing to a minimum. Seats and Discs are machined and fitted simultaneously, assuring perfect mating.
- **Deep Stuffing Boxes with Glands** are fitted with reinforced, molded packing. Valves can be repacked under pressure when fully opened.

For Longer Bronze Valve Life . . .

## "500 BRINELL" PLUG-TYPE STAINLESS STEEL SEATS AND DISCS

150 lb.      200 lb.      300 lb.      350 lb.

• **Oversize Stems**, made of high tensile strength silicon-bronze, assure long life.

• **Rugged Body Hexes**, are flat on top; do not interfere with wrench gripping body-to-bonnet union ring connection.

• **Bodies**, made of Composition M bronze (ASTM B61), have ample wall thickness to provide high safety factor.

• **Patented Handwheels** are air-cooled and designed with a "finger-fit grip." Makes turning easy even when wearing greasy gloves.

• **Identification Plates** secured by lock-washer under stem nut, show Figure Number of valves and make re-ordering sure and easy.

FOR COMPLETE INFORMATION, SEE YOUR WALWORTH DISTRIBUTOR OR WRITE FOR ILLUSTRATED CIRCULAR

# WALWORTH

750 Third Avenue, New York 17, New York

<b>SUBSIDIARIES:</b>	<b>ALLOY STEEL PRODUCTS CO.</b>	<b>CONOFLOW CORPORATION</b>	<b>M &amp; H VALVE &amp; FITTINGS CO.</b>
<b>SW</b>	<b>SOUTHWEST FABRICATING &amp; WELDING CO., INC.</b>	<b>WALWORTH COMPANY OF CANADA, LTD.</b>	

# COMPARE

leading FORGED STEEL UNIONS  
point by point next time you buy

Next time you buy forged steel unions, remember to make this important comparison check! Be sure that you get the unions that have *all* 16 of these quality points, to assure pressure-tightness, ease of installing, interchangeability, and re-useability. Be sure that you get Clayton Mark Petro®—made by the originators of steel unions!

Write—today—for your copy of "How to Tell a Good Union." It describes the importance of the 16 points . . . tells how they add up to better service and complete satisfaction. Order Clayton Mark unions from your distributor; 3000 and 6000-lb. screwed and socket weld types,  $\frac{1}{2}$ " to 3" pipe sizes.



**PETRO UNIONS—Industry's "yardstick" of quality**

QUALITY POINT	Clayton Mark	BRAND A	BRAND B	BRAND C	BRAND D	BRAND E	BRAND F
Made to AAR standard design	●		●	●		●	
Hardness differential between seats	●	●				●	
Cold-rolled female seat	●					●	
45° cone-to-ball seat	●	●	●	●		●	
Cadmium-plated nut	●		●			●	
Ends taper-reamed before threading	●		●		●	●	
Published steel specifications	●				●		
Each union individually tested	●						
Induction-heated for forging	●						
Hot-forged	●		●	●	●	●	●
Octagon wrench flats on ends	●		●	●	●	●	
Octagon wrench flats on nut	●	●	●	●	●	●	
Rounded nut end and wrench flats	●		●		●	●	
Turbulence-free fit across seats	●		●	●		●	●
Machined surfaces finished to "1/40 turn" or finer	●	●			●		●
All sharp corners relieved	●	●					



**CLAYTON MARK & CO.**  
1900 DEMPSTER STREET • EVANSTON, ILLINOIS

## NEW EQUIPMENT . . .

(Continued from p. 82)



### Respirator

Protects wearer against excessive heat.

Used with appropriate heat-reflective clothing, the new Thermalair provides workers with respiratory protection at temperatures up to 300 F. Typical applications include use for routine oven and kiln operations as well as emergency entrances into furnaces and boilers.

Thermalair substitutes respirable air for overheated air. The cartridge contains a metal screen that absorbs heat as the wearer inhales. Absorption is great enough to cool incoming air to about body temperature. Then, as the wearer exhales, stored hot air is forced out.—American Optical Co., Safety Products Div., Southbridge, Mass.

148A

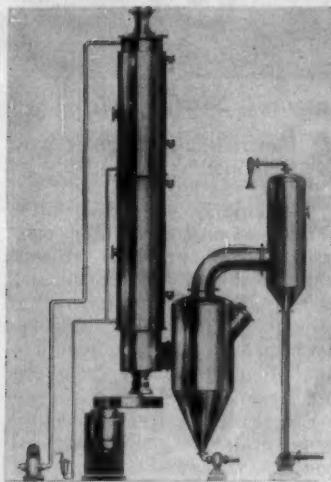
### Finned-Tube Heaters

For installation in floating-roof tanks.

Manufactured in standard modular sizes, the new FR-11 series of finned-tube heaters in no way restricts operation of floating-roof tanks. Maximum installed height is 15 in. from the tank bottom; supporting legs maintain a 2-in. clearance above the tank floor. This clearance, combined with convection effects, prevents heater burial in bottom sediment; it also facilitates tank cleaning.

Fabricated of mild steel,

standard FR-11 heaters have a pressure rating of 600 psi. at 600 F. If desired, the units can also be furnished with chrome alloy or nickel construction. An expansion elbow in each tube stops thermal stress at the welds. — **Brown Fintube Co., Elyria, Ohio.** 148B



#### Evaporator

Rotor agitates down-flowing liquid film.

Roto-Vak, a new tool for the process industries, concentrates a wide range of viscous, foamy or heat-sensitive materials to densities claimed to be heretofore impossible in conventional tubular evaporators. Because contact time between product and heating surface is extremely short, the machine can use temperatures formerly regarded as critical for heat-sensitive materials.

In operation, a spinning rotor agitates a thin film of process liquid flowing down a vertical vaporization tube. Resulting film turbulence promotes superior heat transfer rates, which can be easily regulated to suit the quality requirements for the product.

Observation glasses, vacuum controls and a sampler connection permit closely supervised operation. Manholes provide easy access to bearings, glands and seals. — **Buflovak Equipment Div., Blaw-Knox Co., Buffalo, N. Y.** 149A

**New No. 1003-B1  
TEMPERATURE  
REGULATOR**

(Supersedes  
Type No. 999-T)



**NOW...**

a "premium"

## **FULTON SYLPHON REGULATOR**

at a pinch-penny price

The finest general purpose temperature regulator in the industry. For the first time, you can get premium quality "extras" at no added cost. This new self-powered regulator is trouble-free, powerful and sensitive. Installation is easy and inexpensive. Large Sylphon® Bellows provides perfect stroke action for valves up to 4". Handles pressures up to 250 psi. Designed for extra-long life.



### **new extras at no extra cost:**

1. New Teflon Chevron valve stem packing—no sticking, no leaking, no lubrication . . . ever!
2. New Menel Valve Stem—super-finished to prevent sticking!
3. New "Quick-Detach" stem fitting—valve removable without disturbing adjustments!
4. New Design incorporates "MA" valve—for "dead-end" service!
5. New overrun assembly—prevents regulator damage from over-heating!

WRITE FOR BULLETIN D-XC

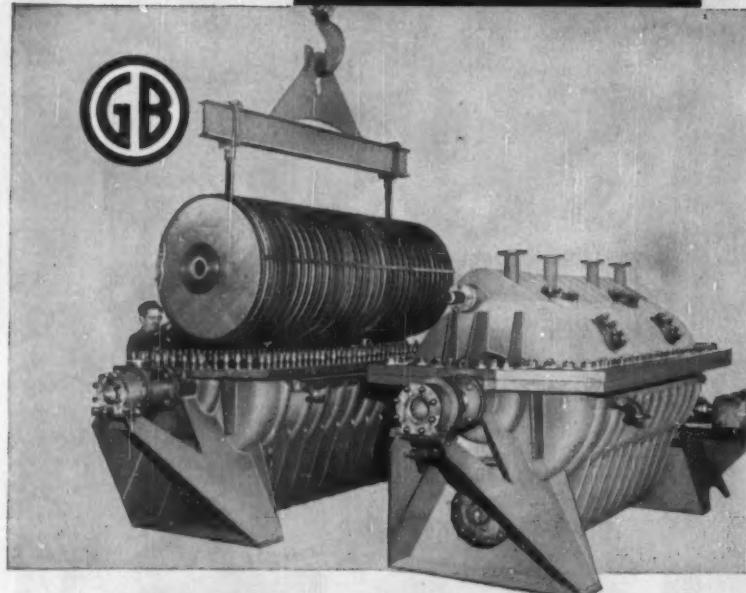


**Robertshaw-Fulton**

CONTROLS COMPANY

**FULTON SYLPHON DIVISION • Knoxville 1, Tenn.**

*The problem: How to handle a hot inflammable liquid under high pressure safely*



## G-B Supplied the answer with these large Vallez Rotating Leaf Pressure Filters

These large Vallez Rotating Leaf Pressure Filters were designed especially for the new Phillips Chemical Company polyethylene plant at Adams Terminal, Texas.

These filters are supplied with a special steam jacket to keep the contents hot and are designed to operate at 160 psig. Special emphasis was given throughout the designing and fabrication of these filters to handle a hot inflammable liquid under high pressure safely. This is typical of G-B engineering know-how.

G-B Engineers are at your service to discuss your processing problems without cost or obligation.

### NEW EQUIPMENT . . .



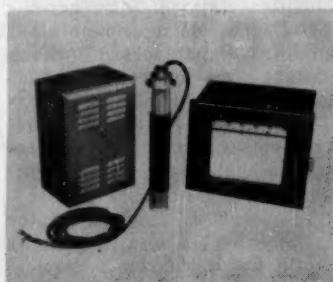
#### Impact Mill

Centrifugally reduces particle size.

Particularly suited for pilot plants, a new Entoleter centrifugal mill operates at any pre-determined impact velocity up to 25,000 ft./min. In addition to its use for particle-size reduction, the mill is applicable to fine blending of any free-flowing materials.

Compactly designed, the unit is adaptable to either batch or continuous flow systems at throughputs of over 20,000 lb./hr. If required, rotors and impactors come in a variety of corrosion- and abrasion-resistant alloys.—Entoleter Div., Safety Industries, Inc., New Haven, Conn.

150A



#### Density Instrument

Suspended plummet senses liquid density.

Model LDI-3 density instrument system is offered as a reliable unit for automatic, continuous monitoring of liquid density. Useful during mixing, transit, storage or throughout complete reaction sequences, the system offers sensitivity and repeatability to better than 0.0001



**GOSLIN-BIRMINGHAM**  
MANUFACTURING CO., INC.  
BIRMINGHAM, ALABAMA

FILTERS • EVAPORATORS  
PROCESS EQUIPMENT  
CONTRACT MANUFACTURING  
including HEAVY CASTINGS

g./cc. Accuracy is normally about  $\pm 3\%$  of indicated span. A Kel-F coating protects all metallic parts contacting liquids under study.

Component parts of the system include a probe, an electronic power unit and an indicator or recorder. In operation, a spheroid plummet within the probe is suspended in the liquid at an exact position under the pole of an electromagnet. A millivolt signal, proportional to the electrical energy required to suspend the plummet, and a zero-suppression voltage act as combined input to the recorder.

—General Communication Co., Boston, Mass. 150B



#### Bulk Container

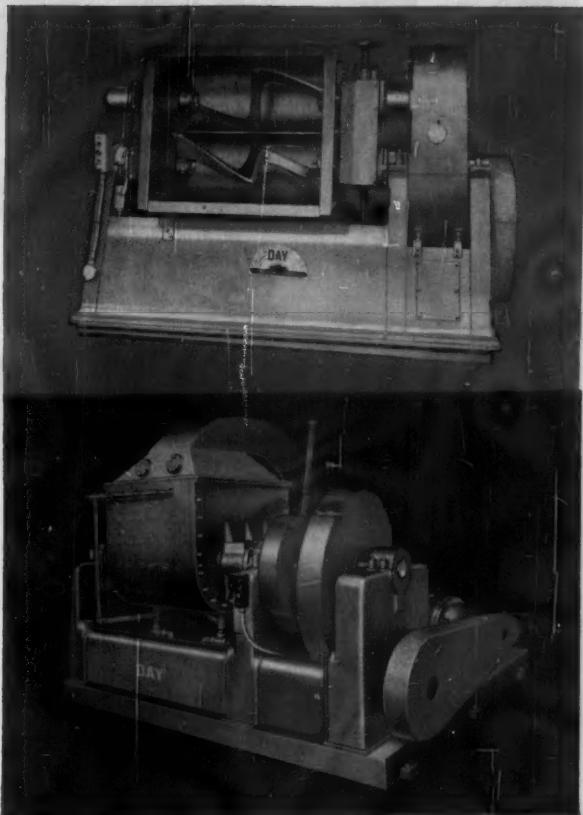
Facilitates handling of free-flowing materials.

Cylndri-Pak, a newly developed wirebound pallet box, appears to be one answer to industry's need for strong, lightweight, economical bulk containers. According to the manufacturer, field experience has proven the new package to be ideal for efficient mechanical handling, storing and shipping of free-flowing granular materials.

Moisture-proof and reusable, Cylndri-Pak is constructed of thin wooden slats bound with galvanized steel wires. This assembly mounts on a plywood base equipped with hardwood skids. Standard outside diameters are 36 and 42 in.; inside heights range from 30 to 72 in.

DAY IMPERIAL

DAY MOGUL



DAY

double arm mixers give  
thorough dispersion  
dependable operation  
fast production

**DAY IMPERIAL** mixers meet every requirement for heavy duty kneading and mixing, and are the result of sound engineering, superior design and superior construction. Counter rotating agitators with 3 to 2 ratio insure thorough mixing and shearing action. Air seal stuffing boxes protect your product from contamination, and guard the heavy duty bearings from damage by abrasive mixtures. Everything about a DAY mixer is heavy, rigid and built for long service. In 35, 50, 100, 150 gal. working capacities—plain or jacketed tanks, tilting or non-tilting. **DAY MOGUL** mixers are the "big boys" in our line. Their effortless mixing of extra heavy materials, like rocket fuel, flushed colors, pastes, putties, furnace cements, etc., means speedy, economical production. They have all the design features of the Imperial and are available in 2½, 5, 100, 150, 200, 300, 600 gal. working capacities.

The popularity of DAY mixers is proven by the high favor they enjoy in hundreds of plants in many industries. They are attractively priced and require a minimum of operation and maintenance expense. Make DAY your one source for all your process equipment requirements. New illustrated Bulletins on complete line of mixing, blending, milling, sifting equipment FREE on request.

*The J. H. DAY Co.*  
Division of Cleveland Automatic Machine Company  
SERVING THE PROCESS INDUSTRY SINCE 1883

4926 BEECH STREET, CINCINNATI, 12, OHIO



## NOW... "SPECS" AT YOUR FINGERTIPS

### Here's a surer, easier way to specify spray nozzles



How can you be sure you're specifying the *right* spray nozzle for your particular application?

Spraco's research department has taken the guesswork out of this problem by preparing complete and accurate performance data for each of the hundreds of spray nozzles in the Spraco line. Each nozzle "profile" is complete with data on material, dimensions, flow rate, pressure, angle of spray . . . everything you need to enable you to choose, at a glance, the nozzle that will deliver maximum performance and efficiency in your particular application.

No matter what your spray nozzle problem, Spraco makes this information available to you absolutely free. Why not write and ask about it — today?

**SPRAY ENGINEERING COMPANY**  
115 Cambridge Street, Burlington, Mass.

# SPRACO



### NEW EQUIPMENT . . .

Maximum capacity is 4,000 lb.—  
General Box Co., Des Plaines,  
Ill. 151A



### Gas Analyzer

Operates on thermal conductivity principle.

Continuous and selective measurement of the concentration of one gas in a multicomponent mixture is the claimed function of the MSA Gas Thermatron. By utilizing thermal conductivity as a means of measurement, the instrument enables accurate gas analysis without causing chemical or physical change of the feed gas mixture.

There are four hot-filament cells in the Thermatron—two for conductivity and two for convective measurements. The convection cells compensate for convective heat losses from the hot filaments. A Wheatstone bridge ties all four cells' filaments together to give desired output.

Accurate to within 2% of full scale, the instrument calibrates for any gas over either narrow (0-1%) or wide (0-100%) ranges of concentration. Speed of response is 60 sec.—Mine Safety Appliances Co., Pittsburgh, Pa. 152A

### BRIEFS

Data-processing systems, each consisting of a G-15 digital computer, a punched-card data processor, conventional card readers and punches, and a tabulator, are available for lease at \$2,500/mo. Manufacturer claims that performance and versatility compare with medium-price systems.—

Bendix Computer Div., Bendix Aviation Corp., Los Angeles, Calif. 152B

Automatic weighing and filling machine has 1:3 and 1:4 ratio ranges, and operates at speeds to 20 weighings/min. Designed for free-, semifree- or nonfree-flowing materials.—Richardson Scale Co., Clifton, N. J. 153A

Specialty valve for instrumentation service has a  $\frac{1}{4}$ -in NPT inlet,  $\frac{1}{4}$ -in. outlet and a  $\frac{1}{4}$ -in. bleed-off connection. The unit is useful as a stop valve between pressure source and indicators, recorders or transmitters. Ratings are 600 psi. at 910 F., and 2,000 psi. at 100 F.—Manning, Maxwell & Moore, Stratford, Conn. 153B

Vibratory feeders, designed for high-capacity operation where installation space is limited, come with capacities from 25 to 1,000 tons/hr. Two electromagnetic drives power each unit.—Syntron Co., Homer City, Pa. 153C

Control valve for abrasive and corrosive slurries is available in  $1\frac{1}{2}$ , 2-, 3- and 4-in. sizes. Plant air controls laminar flow through the Venturi orifice.—The Clarkson Co., San Francisco, Calif. 153D

Packaged load centers for stepping-down primary voltages contain the transformer and its primary protective and secondary distribution devices. The new substations accept input voltages from 2.4 to 13.8 kv.; outputs vary from 208/120 through 600 v.—I-T-E Circuit Breaker Co., Philadelphia, Pa. 153E

Flareless tube fitting that makes a butt joint eliminates need for springing tubing when making connections. Known as Hi-Seal, the fitting can be constructed of either brass, steel or stainless steel.—Imperial Brass Mfg. Co., Chicago, Ill. 153F

Flow meters of the sanitary rotary-piston variety offer great ease of disassembly for clean-

## EASTERN PORTABLE MIXERS

especially  
designed for  
small batch  
processes

offer . . .  
precise mixing  
results with  
long term  
cost savings

Eastern Portable Mixers are especially designed for dependable, low cost service in small batch processes. Where fixed mounted installations are not required, Eastern's Portables offer greater versatility, ease of handling, and long term cost savings.

Speeds of 420, 1125, and 1725 R.P.M. rated from 1/20 to 3 H.P. are standard, with variable speed and air-driven models also available. Motors in all standard types can be supplied in semi-enclosed, totally-enclosed, or explosion-proof construction. Shafts and single or dual propellers are available in a choice of alloys for all service requirements. New optional ball-swivel clamp as illustrated, permits easy adjustment of mixer position in tank.

For a personalized analysis of your mixing problems, send details to Eastern engineers. A recommended solution will be furnished promptly and without obligation. For a helpful guide to mixing fundamentals, write for "Handbook of Fluid Mixing."

### NEW PORTABLE MIXER BULLETIN

Eastern's improved line is included in the revised Portable Bulletin No. 530-B.



**Eastern**



**INDUSTRIES, INC.**  
**MIXER DIVISION**  
Regent Street  
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# SHIPPERS OF CHEMICALS

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steel container*



Extra service from Continental smooths the path of many shippers of chemicals. Besides highest quality containers, Continental gives these shippers the benefits of famous Continental service... faster delivery, engineering and research assistance in solving their packaging problems, and the special protection of Perma-Lined containers for hard-to-hold chemical products. Solve your chemical shipping problems with Continental's steel container service. Call today.

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## NEW EQUIPMENT . . .

ing. Capacity of the stainless steel Siemens units ranges from 8 to 87 gpm. Four types of totalizing registers available.—T. E. A., Inc., Flushing, N. Y. 153G

Tube cleaner weighing only 10 lb. quickly and thoroughly unplugs severely clogged tubes up to 1 in. diameter. Air-driven motor, controlled by a feathering valve in the tool's handle, operates at 3,800 rpm. —The Airetool Mfg. Co., Springfield, Ohio. 154A

Viscometer installs in pipelines or sidestreams to measure viscosity under actual pressure and temperature conditions of the system. Instrument output transmitter sends signals suitable for recorders or controllers. — Norcross Corp., Newton, Mass. 154B

## Equipment Cost Indexes . . .

	June 1958	Sept. 1958
<b>Industry</b>		
Avg. of all . . . . .	230.7	230.9
<b>Process Industries</b>		
Cement mfg. . . . .	222.2	223.3
Chemical . . . . .	231.7	232.3
Clay products . . . . .	216.0	217.0
Glass mfg. . . . .	218.8	219.3
Paint mfg. . . . .	223.1	222.8
Paper mfg. . . . .	223.3	223.8
Petroleum Ind. . . . .	227.9	227.5
Rubber Ind. . . . .	230.7	230.3
Process Ind. avg. . . . .	228.2	228.6

## Related Industries

Elec. power equip. . . . .	234.3	236.0
Mining, milling. . . . .	233.1	233.7
Refrigeration . . . . .	260.7	260.3
Steam power . . . . .	218.4	218.1

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 125-6 for method of obtaining index numbers; Feb. 24, 1958, pp. 143-4 for annual averages since 1913.

## For More Information . . .

about any item in this department, circle its code number on the

## Reader Service

postcard (p. 177)



## HAMMOND TANKS

FIELD ERECTED  
TANKS  
AND VESSELS  
FOR  
LIQUIDS, GASSES  
VAPORS  
AND  
STORAGE OF  
DRY MATERIALS

### FIRE PROTECTION AND WATER SUPPLY



ELEVATED TANKS

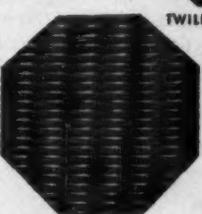
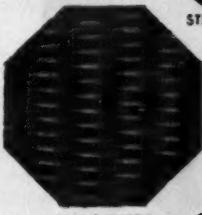
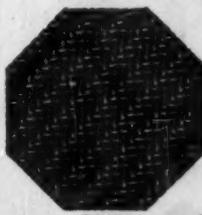
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the U.S.A.

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Newark Metallic Filter Cloth is available in a variety of weaves in all malleable metals, and is adaptable to practically all types of filters. When writing, please give us details on your process.

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Wire Cloth  
COMPANY**

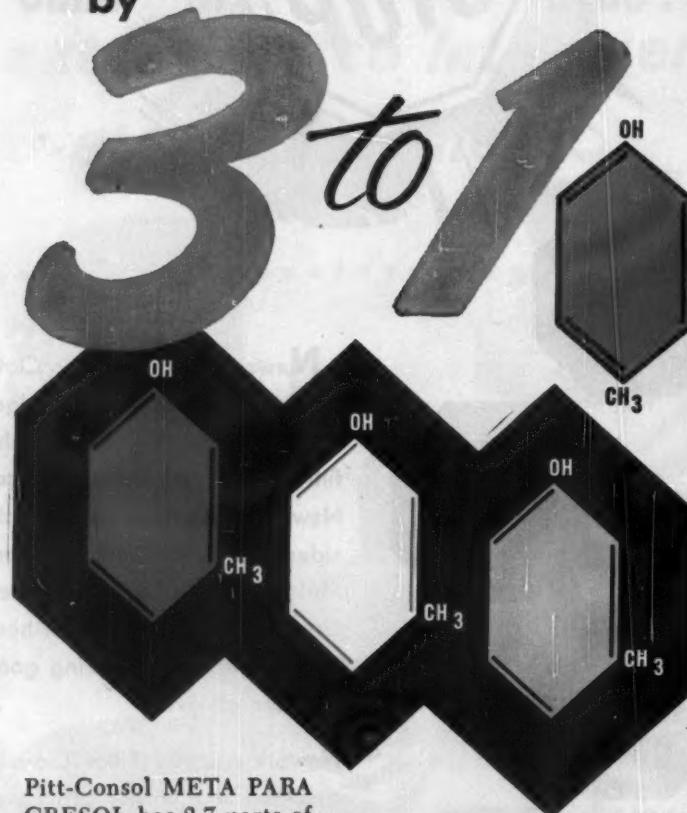
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## TECHNICAL

### To Strengthen Curricula

RECENT ADVANCES IN THE  
ENGINEERING SCIENCES.  
McGraw-Hill Book Co.,  
New York. 256 pages.  
\$4.75.

Reviewed by Seymour C.  
Hyman, Assistant Dean,  
School of Technology, The  
City College, New York,  
N. Y.

This book is the report of proceedings of a conference on science and technology for deans of engineering. The conference was held in September, 1957, at Purdue University, Lafayette, Ind.

Although directed to deans and administrators, this book should be required reading for every member of an engineering faculty. Even those of us who are able to keep abreast of the advances in our own fields need to be informed of the startling developments on other fronts.

Engineering curricula are not made by deans and administrators alone; every teacher has the obligation of updating his course content. For both general and specific suggestions on next semester's curricula and course content, read this up-to-date volume.

An outline of the present status of knowledge and the impact on engineering education is discussed for: Automation and Automatic Control; Operations Research and Systems Engineering; Administrative Problems in Engineering; Thermodynamics; Mass, Momentum and Heat Transfer; Nuclear Engineering; Solid State Physics and Engineering Materials; Computer Development and Application.

There should be a way to give copies of this book to every member of an engineering faculty. It adds specific substance to the recommendations of the American Society for Engineering Education for strengthening curricula in the engineering sciences.

## BOOKSHELF

J. B. BACON

### BRIEFLY NOTED

AMERICAN STANDARD SPECIFICATIONS FOR METAL DRUMS AND PAILS. American Standards Assn., Dept. PR 22, 70 E. 45 St., New York 17, N. Y. Complete set of standards for \$1. Ten specifications give data for 5, 16, 30, and 55-gal. metal drums and pails.

FREE RADICALS (COLLECTED PAPERS OF FRANCIS OWEN RICE (1). 278 pp. Catholic University of America Press, 620 Michigan Avenue, N. E., Washington 17, D. C. \$5. Contains author's contributions (1931 to 1958) in the field of free radicals.

SURFACTANTS LISTED. 78 pp. By John W. McCutcheon. John W. McCutcheon, Inc., 475 Fifth Ave., New York 17, N. Y. \$2.50. Gives general summary of detergent field and alphabetical listing of more than 2,000 U. S. trade-named products, together with manufacturer, class and formula.

SOVIET ABSTRACTS — Section 1: Chemical Technology. Office of Technical Services, Dept. of Commerce, Washington 25, D. C. \$1. Translation of Soviet Chemical Abstracts Journal.

### MORE NEW BOOKS

PHOSPHORUS AND ITS COMPOUNDS; Vol. 1: Chemistry. By John Van Wazer. Interscience. \$27.50.

BIG MOLECULES. Sir Harry Melville. Macmillan. \$3.95.

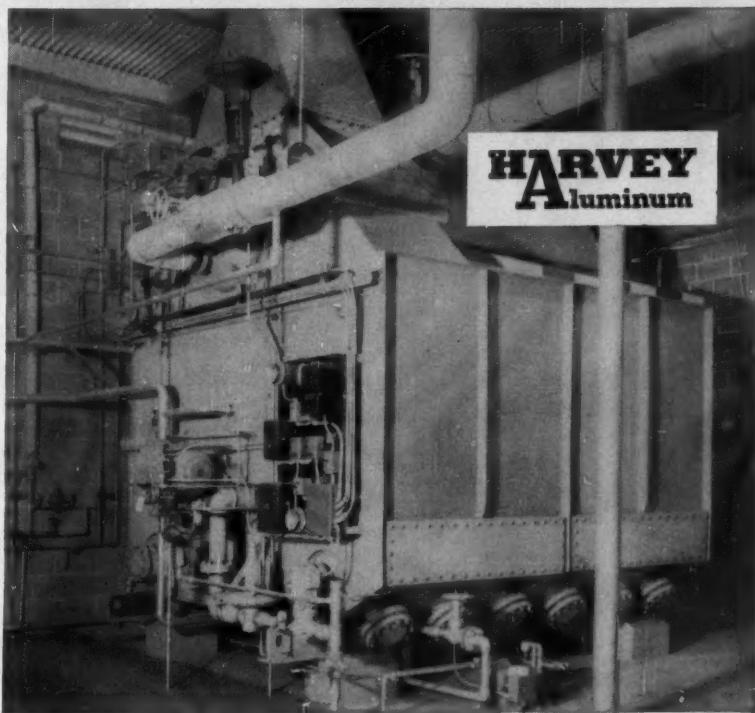
PROCESS DYNAMICS—Dynamic Behavior of the Production Process. By Donald P. Campbell. Wiley. \$10.50.

PETROLEUM—Prehistoric to Petrochemicals. By G. A. Purdy. McGraw-Hill. \$15.

ELECTROANALYTICAL CHEMISTRY. By James J. Lingane. Interscience Publishers. \$14.50.

GMELINS HANDBOOK OF INORGANIC CHEMISTRY: GERMANIUM (Supplement), \$80.88; HAFNIUM (Supplement), \$5.28; OXYGEN, Part 3, \$67.82; ZIRCONIUM, \$63.84. Verlag Chemie GmbH.

## Producing high temperatures at low pressure



### Union Packaged Vaporizer plays key role in aluminum reduction

Harvey Aluminum, world's largest independent producer of wrought aluminum mill products, selected this Union Packaged Vaporizer to deliver high temperatures and low pressure for its aluminum reduction process.

Featuring compact 3-drum design, extremely large heating surface, and completely automatic controls the Union Vaporizer is installed in Harvey's smelting plant which produces aluminum pig, ingot and billet. It serves four continuous mixers turning out carbon electrode paste for the reduction cells. Summing up the reasons for its choice, Harvey Aluminum says: "Investigation of similar Union installations indicated the equipment to be well designed and built. Production people were well pleased."

Throughout industry, Union Vapor-

izers handle a wide variety of process requirements, providing a broad range of accurately controlled temperatures at low pressure. Both packaged and field erected units can be outfitted for heating with oil, gas, waste heat or special fuel in outdoor and indoor installations.

Union also produces a complete line of Process Heating Equipment for use with Dowtherm "A" and "E", Para-Cymene, Anisole, Aroclor #1248 and Heat Transfer Oil, either convection, or forced circulation.

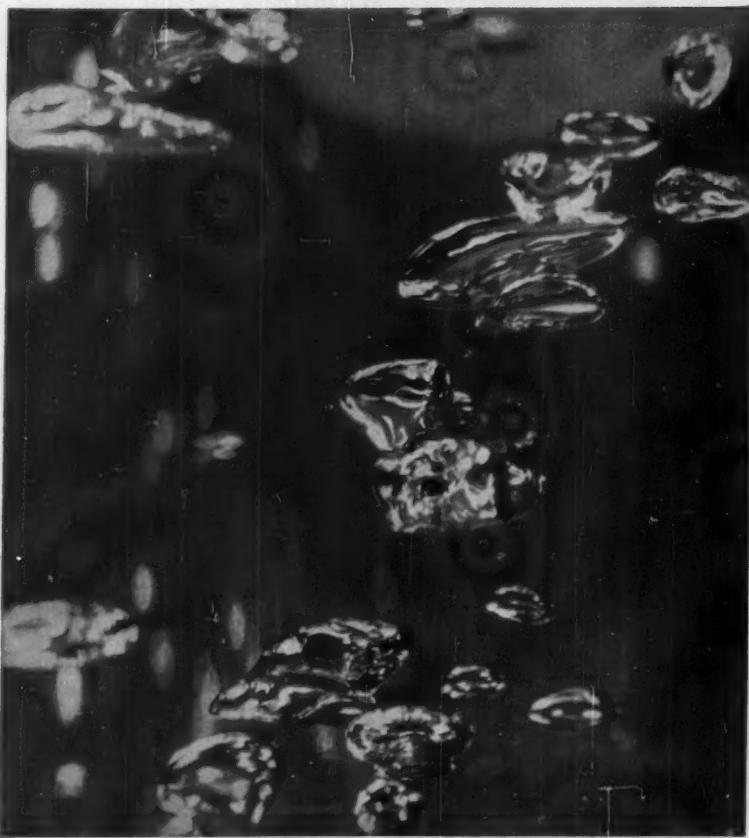
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the whole story.  
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your copy.



## IRON WORKS

Erie, Pennsylvania



Bubbles in boiling liquid were "frozen" with stop motion by photographer Bernard Hoffman.

## Controlling Temperature in Fluid Engineering

Heat is generally only one part of your problem. Pressure, abrasion or corrosion factors usually must be taken into account, too. So if your past experience offers no precedent, you can look to S. Morgan Smith's specialized engineering leadership for assistance.

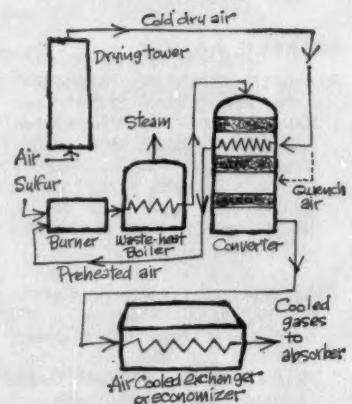
A number of materials are available to meet extreme working conditions. Here the broad SMS background combines with specialized valve engineering to help you. Perhaps R-S Butterfly Valves can be applied to control volume and flow at high temperatures. Or, if heat and corrosion make extremely accurate timing and fast, drop-tight closure a tough problem, an SMS Rotovalve could be the answer. Whatever your special processing needs, you can get help in protecting your equipment investment.

There is a full SMS line — standard R-S Butterfly Valves ready for fast assembly and shipment from stock, Rotovalves and Ball Valves. A call to our nearest representative will bring information. Or, write S. Morgan Smith, York, Pa., for data on standard valves or special applications.

**S. MORGAN SMITH** 

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO  
Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge  
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## LETTERS:



### Con: Acid Plant Novelty

Sir:

In your October 6 *Chemen-tator* (p. 45), we are astonished that you should consider the diagram as representing a "new look in small sulfuric acid plants."

That design is very old, not only in plants of Monsanto design but also in the plants of others. Many similar variations in the means of interstage cooling in a converter and in the entire plant are also in use.

There is nothing inherent in that or similar designs which leads to lower plant costs. If a complete 100-ton sulfur-burning plant can be built today for \$350,000, it is certain from our experience that maintenance and acid costs will be higher and plant life shorter. It is still true that one gets about what he pays for.

C. M. DEAN  
Monsanto Chemical Co.  
St. Louis, Mo.

Sir:

In your October 6 *Chemen-tator* you state: "As much as 20% reduction in cost of moderate-size contact-process sulfuric acid plants is claimed by D. M. Weatherly Co. . . ." This process involves preheating the dry air to the furnace with the heat from the first contact mass in the converter.

This is not new, but has been used by the Titlestad Corp. since

## PRO & CON

C. H. CHILTON

1947. Titlestad has built plants using this exact process method in sizes from 25 to 600 tons/day.

The use of quench air between the second and third contact stages also is not new, but has been used by Titlestad in practically all plants built since 1947.

TIM J. BROWDER

Titlestad Corp.  
New York, N. Y.

► Although we couldn't find this process flowsheet in the usual reference works on chemical technology, the above evidence certainly discredits any claim for novelty.

However, Weatherly's claim of 20% lower cost is more difficult either to support or disprove. We're sure that Messrs. Dean and Browder don't mean to imply that sulfuric acid technology has advanced beyond the point of any further engineering improvements. As pointed out clearly in our story, the heat-transfer system accounted for only part of the claimed savings. The rest came from other changes in drying and absorption, together with a simpler plant layout.

And Mr. Dean's truism about getting what you pay for overlooks the fact that you sometimes get—and pay for—chrome trim that you really don't want.—ED.

### Solar Energy Storage

Sir:

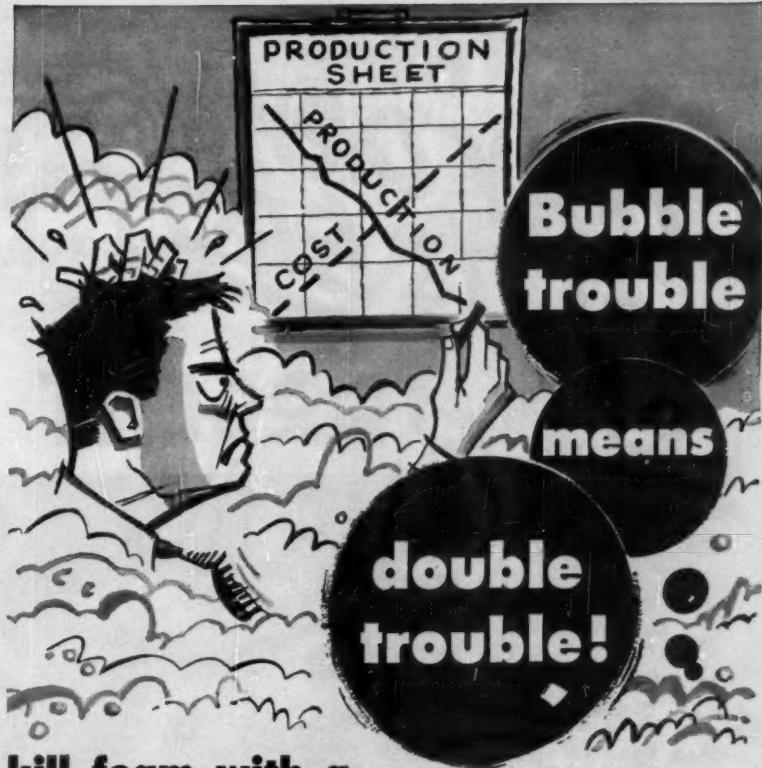
In your May 5 issue you carried a short item about chemical storage of solar energy in acridine dyestuffs. You said that BASF in Germany was trying this.

Desiring further information on this development, I wrote to BASF. I am enclosing a copy of their reply. From this it would appear that the item in your magazine was in error.

ROBERT ALLDREDGE  
Alldredge & McCabe  
Denver, Colo.

► Our McGraw-Hill Bureau in Bonn checked the original item with BASF before it was sent to us; at the time BASF was more noncommittal than negative.

Upon receiving Mr. Alldredge's letter we again checked with BASF



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3,125,000 lb cellulose slurry

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distillation mix

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COMPANY		
CITY	ZONE	STATE
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My foamer is

Oil system \_\_\_\_\_

Aqueous system \_\_\_\_\_

Food products \_\_\_\_\_

Other \_\_\_\_\_

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by SARGENT

9-tray Sargent Dryer for reclaimed rubber. Equipped with explosion-proof latch so that door in back simply opens should pressure build up within the dryer. Installation in large chemical plant.



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There's a Tray Dryer by Sargent to do the job. From one tray to dozens; from small table or lab models to huge, multi-stacked, multi-tray jobs; from slow drying cycles for sensitive or unstable materials to high-speed drying where "flash" methods are indicated.

All are of Sargent's famous dependably sturdy and trouble-free design and construction; completely automatic operation with simple changeover to manual for small test or research runs; fully instrumented; Guaranteed performance and complete product control; product protection with uniform quality results every charge. All are performance-proven with a wide variety of products — from abrasives to waste sludge.

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CHICAGO 44 — John Low & Co., 5830 West Lake St.  
DETROIT 27 — Clifford Armstrong Co., 16187 Grand River Ave.  
HOUSTON 17, TEX. — The Alpha Engineering Co., Box 12371  
CHARLOTTE, N.C. — W. S. Andersen, Carolina Specialty Co.  
ATLANTA, GA. — J. R. Angel, Mortgage Guarantee Building  
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### PRO & CON . . .

and obtained a statement which includes the following:

"From the possibility of using acridine dyestuffs for energy storage and the fact that acridine dyestuffs are produced by BASF, one should not conclude the BASF is active in this special field." —ED.

### Lost: Growth Opportunities

Sir:

As the wife of a chemical engineer, I find your articles and letters about professional opportunities most interesting. Right now I am wondering about my husband's opportunities 22 months hence, when he can once more engage in the profession for which he was trained.

Our problem is, unfortunately, quite common. Upon receiving his B.S.Ch.E. degree, my husband chose to work with the atomic energy department of a well-known firm. His professional life was interrupted after just six weeks, when he was called into active duty in the Air Force by virtue of the commission he had acquired in ROTC.

Since the start of his active duty 14 months ago, my husband has done absolutely nothing to which he could apply his special and intensive knowledge of engineering and chemistry. On the contrary, the military positions he has occupied have been such that an intelligent clerk could fill them. With 22 months more of such professional and intellectual inactivity facing him before he can hope to put his education to use, we wonder just how good a chemical engineer he will be.

There are, at our present base, dozens of other men with similarly specialized knowledge—many of them chemical engineers—whose story is much the same. This waste is depriving the military of the technical manpower it apparently needs, as well as depriving the engineers the opportunities for professional growth and experience they also must have.

Must the young engineers of this country deny themselves to this extent when they voluntarily accept military responsibility?

NAME WITHHELD  
Layton, Utah

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HELPFUL  
FREE . . .

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### Chemical Engineering Reader Service

STARTS  
ON  
PAGE 162



### THE PERFECT HEAT EXCHANGER

The new "compression head" design, illustrated in the breakaway, provides even greater resistance to internal as well as external physical abuse, and consequently results in more maintenance-free operation over a longer period of time.

The CROSS-BORE exchanger is a new design which reflects all of the advantages of impervious graphite, particularly its property of possessing one of the highest rates of thermal conductivity of any commercially available material of construction. In addition, the CROSS-BORE is unaffected by all corrosives except a few highly oxidizing agents, features strong, shock resistant construction, possesses 20% higher overall heat transfer coefficient than tube and shell design, provides for fast, positive cleaning of shell side as well as tube side holes, is immune to thermal shock, accommodates working pressures to 200 psi at temp. to 340°F., (specials to 400°F.) and is available in 14 standard capacities to 470 sq. ft. of transfer surface.

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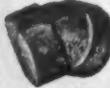
W-S Forged Steel Fittings fit the pattern of all top quality products. The best costs no more in the long run. In terms of trouble and inconvenience, second-best will always be expensive. These are the reasons why you are money ahead to insist on C-1025 W-S Fittings.

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- Special bar quality steel for density, strength, and consistent composition. Install 'em and forget 'em.
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- Heat coded to insure identification.
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For information about 1025 steel and for your commercial forging requirements, write to Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, New Jersey.



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Stainless Steel Works, Duncannon, Pa.



READER SERVICE . . .

## TECHNICAL

### Contents of This Issue

Chemicals & materials . . .	162
Construction materials . . .	164
Electrical & Mechanical equipment . . . . .	165
Handling & Packaging . . .	166
Heating & Cooling . . .	167
Instruments & Controls . . .	168
Mechanical equipment . . .	165
Pipe, fittings, valves . . .	170
Process equipment . . .	172
Pumps, blowers, compressors . . . . .	176
Services & processes . . .	180

### Chemicals

**Adhesive** . . . 8 p. brochure discusses company's new 910 adhesive, a cyanoacrylate said to form remarkably rapid and strong bonds between wide variety of materials.  
162A Eastman Chemical Products

**Alloy** . . . 2 p. technical data card, TDC-189, tells of high temperature properties of B&W Croloy 16-13-3, chemical composition, size ranges, tensile & rupture properties.  
162B Babcock & Wilcox Co.

**Ammonia** . . . 40 p. bulletin tells of purchasing, handling, storage, and uses. Photos, tables and figures illustrate sections on both aqua and anhydrous.  
162C Pennsalt Chemicals Corp.

**Caustic Soda** . . . 26 p. profusely illustrated handbook includes basic information on the various commercial forms of caustic soda. Details handling procedures.  
162D Stauffer Chemical Co.

**Chemicals** . . . Expanded & completely revised 64-page catalog describes the composition, properties & uses of Antara products. Divided into separate sections.  
67 \*Antara Chemicals

**Chemicals** . . . 3 p. tabular brochure contains data on such products as phosphorus, phosphoric acid, sodium phosphates, organic phosphates and sodium chloride.  
162E Electric Reduction Sales

**Chemicals** . . . A 16-page booklet lists the many chemicals available, such as; vinyl stabilizers, fluorides, glycerine, synthetic optical crystals, fungicides, etc.  
88 \*The Harshaw Chemical Co.

**Chemicals, Aromatic** . . . Newest issue of company's semi-annual price list, 36 p., is dated October 1958. Descriptions and market information cover aldehydes, gums, oleoresins.  
162F Dodge & Olcott, Inc.

\* From advertisement, this issue

## LITERATURE

E. M. FLYNN

**Chrome Complex**.....9 p. booklet describes uses for Quilon chrome complex in paper products, textiles, leather, felt, glass fiber. Section on treating solutions.

163A Du Pont Co.

**Dicyclopentadiene**.....Useful in the production of metallic derivatives. Complete information on specifications & characteristics on this & other high quality petrochemicals.

59 \*Enjay Company, Inc.

**Flashing, Plastic**.....4 p. brochure describes advantages, physical data and specifications of Saraloy 400, a new elastic flashing based on a copolymer of vinylidene chloride.

163B Dow Chemical Co.

**Foam Liquid**.....binds large volumes of air & water into a fast, inexpensive fire extinguishing agent. Illustrated booklet on fire-fighting products is offered.

18-19 \*Rockwood Sprinkler Co.

**Furfuryl Alcohol**.....or liquid resins made from it, cure rapidly without external heat to give infusible, insoluble polymers with high tensile strength. Information.

73 \*Quaker Oats Co., Chemical Div.

**Generator, Gas**.....for production of oxygen-free gas. Units in capacities of 100 cfm to 10,000 cfm. Complete catalog material & data is available.

77a \*Engelhard Industries, Inc.

**Laminate, Epoxy**.....2 p. bulletin describes Grade EP-22, a paper-base, epoxy resin laminate designed for printed circuit and other electronic applications.

163C Synthane Corp.

**Metallic Nitrates**.....Cadmium, nickelous, cupric, lead, manganese, aluminum & other metallic nitrates are now available. Technical bulletins are offered.

55 \*Allied Chem., Gen. Chem. Div.

**Meta Para Cresol**.....is part of a full line of high quality phenols, cresols & cresylic acids produced by continuous extraction process. Data available.

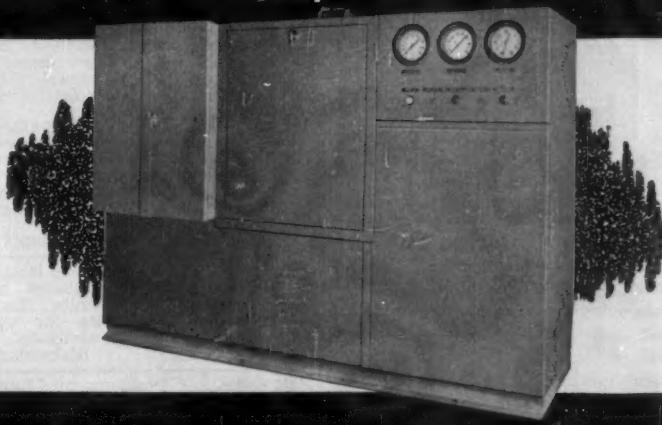
156 \*Pitt-Consol Chemical Co.

\* From advertisement, this issue

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NOW... with the new Series 20 Packaged Firing Unit you can have all the advantages of the outstanding Dual Stage burner in a completely packaged unit equipped with the latest in electronic safety controls to give *automatic* start, *automatic* modulation, *automatic* shutdown.

Series 20 Packaged Firing Units are factory fire tested, ready for immediate and low cost installation in your furnace room. They need only oil, gas, steam, draft and electrical connections—everything else needed for fully automatic burner operation is there.

Capacities of standard units range from 200 to 830 boiler horsepower. (7,200 to 30,000 pounds of steam per hour). Larger units are available on order to meet your special needs.

Units may be used with any standard boiler or furnace under natural or induced draft, or with pressurized boilers—in which case the unit provides sufficient forced draft to overcome draft loss through boiler. Where a high chimney or induced draft fan is used, an automatic damper motor is furnished to provide a constant furnace draft during operations; and a reduced or zero draft during shutdowns.

Preventative Maintenance consists chiefly of keeping the burner gun clean, with periodic inspection and cleaning of strainers and safety devices. This minimum maintenance will give your engineer or fireman extra time to attend to blow-down, soot-blowing, or to check operations and efficiency of plant and auxiliary equipment.

For complete details, specifications, illustrations, and dimensions write today for Bulletin No. 28.

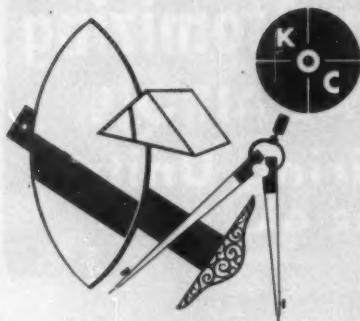
When used in conjunction with a National Airoil Fuel Oil Pumping and Heating Unit (Bulletin No. 40) a most reliable combination results.

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BURNER COMPANY, INC.

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have investigated are  
specifying the

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Above is shown a typical installation—a Dean Thermo-Panel Coil suspended in a tank. It requires about one-half as much space as the old-fashioned pipe coil. Installation is more easily and quickly installed and removed. Usually costs considerably less. Is more efficient and economical. In fact the Dean is superior in **EVERY** way.

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Backed by 20 Years of Panel Cell Manufacturing.

JEAN THERMO-PANEL COIL DIVISION  
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## LITERATURE

**Molecular Models** . . . . Full color folder describes new polyvinyl chloride models with which you can construct all organic forms which can exist. Kit contains 100 atoms.

164A Will Corp.

**Perchloroethylene** . . . . 4 p. "Perclene Perchloroethylene, the Ideal Cold Cleaning Solvent" describes a new way to evaluate safety of solvents used in cold cleaning metal parts.

164B Du Pont Co.

**Plasticizer** . . . . 2 p. bulletin covers butyl oleate, a low temperature plasticizer for natural and synthetic rubbers. Gives chemical composition, specifications, uses.

164C Harwick Standard Chemical

**Plastics** . . . . Pocket-size 12-p. reference booklet contains decimal equivalent chart and handy ruler for measuring plastics sheet, rod & tubes.

164D Commercial Plastics & Supply Co.

**Plastics** . . . . Large family of laminated plastics, known as Insurok, is described in 12 p. catalog. Includes tables of properties for various grades, fabrication methods.

164E Richardson Co.

**Salt Cake** . . . . Problems with handling salt cake are treated in 8 p. fact file, "Properties, Storage and Conveying of Salt Cake." Five tables, eight drawings.

164F Fuller Co.

## Construction Materials

**Aluminum Casters** . . . . All aluminum casters for lightweight, heavy-duty trucks are described in a new brochure. Useful in a wide variety of process industries.

164G M. Neushul Co., Inc.

**Bearings** . . . . Teflon Bearings for equipment where a chemically inert, non-corrosive, non-contaminating & non-adhering material is a must. Details in Bul. CP-558.

R181 \*Chemical & Power Prod., Inc.

**Coatings** . . . . Plasite corrosion-resistant coatings are formulated with a combination of high resistant resins for highest chemical resistance.

R192 \*Wisconsin Protective Coating Co.

**Coatings, Surface** . . . . Solvents assure complete formulating flexibility. Resins produce finishes that resist abrasion. Write for information on specific products.

Cover \*Shell Chemical Corp.

**Custom Fastenings** . . . . Custom-made nuts, bolts, studs and screws for industrial use are illustrated and described in a new 12-page brochure. Send for your copy.

164H Victor Products Corp.

**Fabrication Pipe** . . . . A specialized activity at Vulcan is now offered. All work supervised by master metalsmiths on manifolds, jacketed or lined piping.

8-9 \*Vulcan-Cincinnati

**Hard Surfacing** . . . . Equipment consists of a tungsten carbide spray powder plus a special application gun. Resulting surface resists heat, galling, abrasion, corrosion.

164I Kennametal Inc.

\* From advertisement, this issue

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LITERATURE . . .

**Insulation** . . . 2 p. leaflet describes fiber glass reinforced polyester insulating stock cut into angles or channels for uses as structural insulating members.

165A

Glastic Corp.

**Insulations** . . . Thermobestos is made from hydrous calcium silicate . . . molded to size for proper fit. Its adaptable for fabrication of fittings & bends. Booklet IN-169A.

14-15

\*Johns-Manville

**Linings** . . . Permbond S5471 is the right lining for all chemical processors who use highly corrosive chemicals. Also containers of corrosive acids.

133

\*U. S. Rubber

**Plastic Products** . . . Catalog describes materials in sheet, rod, tube and film form that can be supplied to specifications from large warehouse stocks.

165B

Cadillac Plastic

**Platinum Cladding** . . . of sheet, tubing & wire incorporates the important corrosion-resistant qualities of the noble metals in equipment. Catalog gives details.

77c

\*Engelhard Industries, Inc.

**Rolling Scaffold Towers** . . . Bulletin 66 explains various applications of scaffold used as rolling towers, as well as work staging for maintenance work.

165C

Beaver-Advance Corp.

**Spinnerettes** . . . Precious metal & stainless steel with rigidly controlled hardness & grain characteristics. Available in standard & special design. Brochure offered.

77b

\*Engelhard Industries, Inc.

**Stainless Steel, Cast** . . . New folder lists 29 heat and corrosion resistant alloys for the manufacture of custom castings. ACI, AISI, SAE, ASTM designations.

165D

Cooper Alloy Corp.

**Steel Bars** . . . An 11 x 17-in. wall chart lists all AISI grades of cold finished steel bars. Charts list 241 grades of steel. Machinability ratings given.

165E

La Salle Steel Co.

**Teflon Rod Stock** . . . Brochure gives sizes available, new engineering data, tips on machining, and typical uses of Teflon rod stock. Diameters from 1/32 to 2 in.

165F

Chemplast, Inc.

ELECTRICAL & MECHANICAL

**Bus Design** . . . Complete information about low voltage bus design & fabrication service contained in Bul. 1220C. For electrochemical & electrothermal processes.

94

\*I-T-E Circuit Breaker Co.

**Drive, Motor** . . . Ampli-Speed is a simple, compact magnetic slip coupling that gives adjustable speed control. Illustrated literature available. No. 243.

86

\*Electric Machinery Mfg. Co.

**Electrical Equipment** . . . Catalog 3400 contains detailed descriptions & specifications on explosion-proof electrical equipment for hazardous areas.

33-38

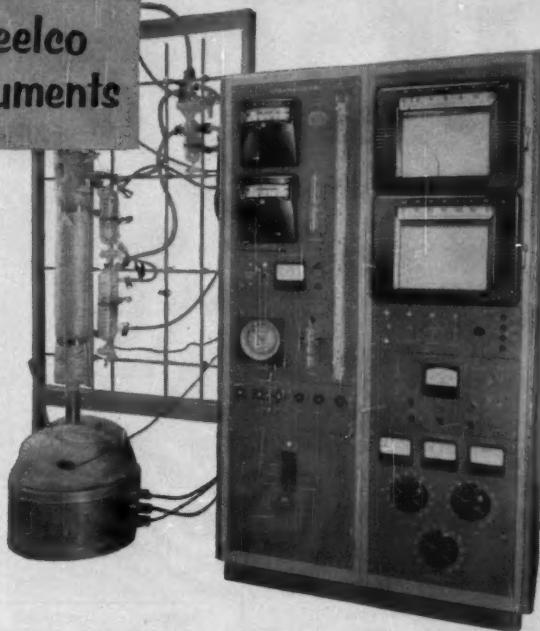
\*Crouse-Hinds

\* From advertisement, this issue

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Precision  
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Product Research

Here's a completely instrumented unit that plays an important part in major oil company research aimed at developing new products and improving existing ones. Known as a "Sarnia Fractionator," it is a development of H. S. Martin Company, Evanston, Illinois.

Upper recorder, with a 12 mv range, records and controls vacuum from atmospheric to .01 mm pressure while the lower recorder is a multipoint unit that reads and records various zone temperatures in the fractionating equipment. The two controllers at the upper left of panel control temperature of charge and product stream of the equipment.

Ranges, control forms, and accuracies of all instrumentation in this installation are ideally matched to equipment needs to provide outstanding performance at realistic cost. The same qualities of process instrumentation experience and clear-headed practicality can be applied to your next job — just get in touch with your nearby Wheelco field engineer for details.

**BARBER-COLMAN COMPANY**

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## Heating &amp; Cooling

**Chain** . . . . Improved Thermoprufl chain provides up to 1/3 more heat transfer surface for kilns, wash mills, etc.; reduces operating costs; provides extra metal.  
167A Allis-Chalmers

**Dryers, Vacuum Shelf** . . . . enable the safe drying of heat or air-sensitive materials which must remain dormant during processing. Other type dryers available. Write.  
42 \*Stokes Corp.

**Duplex Tubes** . . . . handle corrosion problems or unusual pressure-temperature conditions in condensers & heat exchangers. Write for detailed information.  
1 American Brass Co.

**Furnace Equipment** . . . . for thermal processing of all types of chemicals & minerals ranging from laboratory size 10 lb. batch units to 10,000 ton per day plants. Bul 233.  
29 \*Nichols Engineering & Research

**Generators, Hot-Water** . . . . Newly revised specification sheets, with an emphasis on engineering, describe the manufacturer's line of hot water generators.  
167B Cyclotherm

**Generator, Steam** . . . . A packaged, 2-drum water-walled steam generator for oil-gas-coal comes complete, ready to go function as an oil-gas unit. Conversion possible to stoker.  
167C Erie City Iron Works

**Generator, Steam** . . . . Produces 100-psi. steam with a water to steam conversion efficiency in excess of 95%. The 10-kw. unit operates from a 208-220-v. supply.  
167D Tejax Sales Co.

**Heat Exchanger** . . . . Informative booklet on heat exchanger design, when heat transfer specifications call for aluminum . . . or aluminum bronze, nickel, copper, etc.  
13 \*Downington Iron Works, Inc.

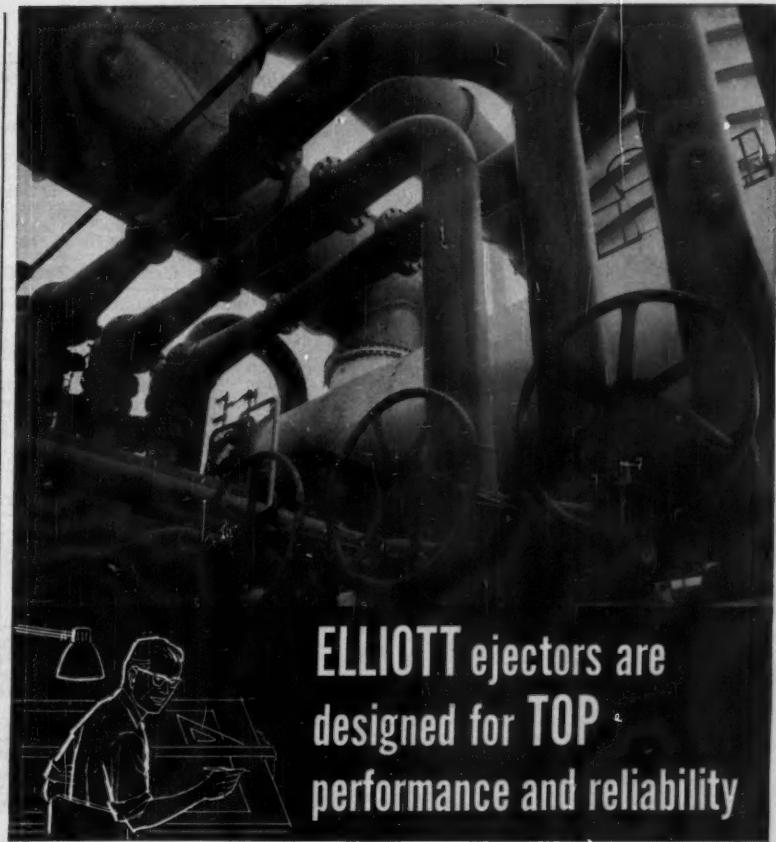
**Heat Exchanger** . . . . Sectional Aero heat exchanger gives close temperature control. Capacity range is 7,000,000 to 18,000,000 Btu./hr. Details in Bul. 132.  
T191 \*Niagara Blower Co.

**Heat Exchanger, Plate** . . . . Illustrated booklet No. S.A1067 gives details & specific examples of better process control & profitable heat recovery.  
6-7 \*De Laval Separator Company

**Heat-Exchangers** . . . . The Cross-Bore is immune to thermal shock, accommodates working pressures to 200 psi at temp. to 340 F., & available in 14 standard capacities.  
161 \*Falls Industries Inc.

**Heat Transfer Equipment** . . . . and other process equipment to suit your needs. Details available on crystallizers, evaporators, condensers, evaporators, etc.  
195 \*Chicago Bridge & Iron Co.

**Packaged Firing Units** . . . . Capacities of standard units range from 200 to 830 boiler horsepower. Details, specifications, illustrations & dimensions in Bul. 28.  
163 \*National Airoll Burner Co.



**ELLIOTT** ejectors are  
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performance and reliability

... engineered and built  
to meet your requirements

An unusual example of Elliott's engineering experience in designing and building steam jet ejectors and auxiliary equipment for producing vacuum is seen above. This photo shows the three first-stage ejectors of an Elliott triple element two-stage unit which serves a residuum stripper in a California oil refinery.

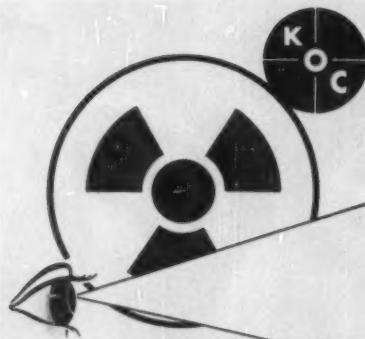
The vapor load from this vacuum flash unit adds up to approximately 57,000 lb per hr of steam, condensable hydrocarbon vapor and noncondensable gas. To handle this load efficiently and economically requires maintaining approximately 2 in. Hg absolute pressure continuously. Two Elliott 11,000-sq ft surface condensers are used, arranged in parallel, and the Elliott triple, two-stage ejector which serves these condensers is discharged to an intercondenser and an after-condenser combined in a common shell.

*wide range of single-stage and multistage types*

of Elliott steam jet ejectors is available for maintaining low absolute pressures in refineries, chemical plants and other processing industries. For complete data or engineering assistance, call the Elliott ejector specialist at your nearby Elliott District Office, or write Elliott Company, Jeannette, Pa.

**ELLIOTT Company** 

\* From advertisement, this issue



## eyeway to a hot cell

A number of reactors—including the newest commercial one at Shippingport—use KOC periscopes for underwater inspection of fuel elements. These devices are dramatic demonstrations of Kollmorgen's ability to solve remote viewing problems through a skillful combination of optical and mechanical knowledge. For literature, write to Dept. 34D.

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Gases } or CONTAMINATION  
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Wavelike Motion of Steel Finger



Prices range from \$60.00 to \$550.00 depending on size and accessories

Write for Catalog.

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## LITERATURE . . .

**Steam Generators** . . . . Package type & custom built units are available in a wide range of types, capacities & pressures to meet operating requirements. Bulletins 24A-BC.  
106 \*Henry Vogt Machine Co.

**Submerged Combustion** . . . . Booklet describes in brief the applications for submerged combustion equipment. Units primarily for evaporation and/or heating.  
168A Ozark-Mahoning Co.

**Thermo-Panels** . . . . take the place of pipe coils. Weighs less & takes less space. Facts and complete technical data on all types is available. Send for data now.  
BL164 \*Dean Products, Inc.

**Vaporizers** . . . . both packaged & field erected, can be outfitted for heating with oil, gas, waste heat or special fuel in outdoor & indoor installations. Bul. "DV".  
137 \*Union Iron Works

## Instruments & Controls

**Analyzer, Particle Size** . . . . a general purpose device for measuring size distribution of small particles, especially subsize particles between 0.1 & 40 microns. Bulletin 25 \*Mine Safety Appliances Co.

**Annunciator** . . . . Four-page folder discusses a new recording annunciator that prints a tape record of times of off-normal and off-on operations.  
168B Panellit, Inc.

**Control Centers** . . . . feature increased safety, flexibility and installation and space economy. Bulletin offered outlines complete details of Control Centers.  
43 \*Square D Company

**Control Valve** . . . . The OPW-Jordan temperature control valve now incorporates Teflon-impregnated asbestos stem packing. Inert, the packing will not shrink, swell.  
168C Jordan Industrial Sales

**Controller** . . . . Bulletin A 130, offers complete data on Series 500 pneumatic controllers. Several hundred standard models meet every process requirement.  
84 \*The Bristol Company

**Differential Producers** . . . . Bulletin 100-P6 includes simplified formulas and tables for calculations of head loss and throat size for Dall tubes, venturi's, etc.  
168D Builders-Providence, Inc.

**Electronic Recorder** . . . . Accepts a.c. and d.c., high and low impedance, isolated and non-isolated inputs. Range of 10-100 mv. with sensitivity of 0.1%.  
168E The Hays Corp.

**Equipment, pH** . . . . features printed circuitry, plug-in assemblies & ruggedized industrial electrodes. Data File P-2-14 offers instrument specifications.  
27 \*Beckman Instruments, Inc.

**Flowmeter** . . . . High-pressure armored Flowmeter Meter has a maximum pressure rating of 2,500 # ASA and is suitable for elevated temperature applications.  
168F Fischer & Porter Co.

\* From advertisement, this issue

## THE *Rotor Lift* ELEVATES AND CONVEYS BULK CHEMICALS

MORE SAFELY  
MORE DEPENDABLY  
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SUPPLY and MACHINE WORKS  
OKLAHOMA CITY, OKLAHOMA**

LITERATURE . . .

**Gages, Heated** . . . . In the complete line there is a model to meet your specific needs . . . heated by steam or electrically . . . heavy or viscous liquids. Catalog offered.

R174 \*Jerguson Gage & Valve Co.

**Indicator-Recorder** . . . . A high-speed electronic indicator-recorder features continuous standardizing, fast balancing speed, elimination of overshoot. Pub. 296A.

169A George Kent Ltd.

**Indicators, Level** . . . . A consolidated catalog for all three Bin-Dicators includes photos, cutaway and schematic drawings. Also specifications and applications.

169B The Bin-Dicator Co.

**Information Systems** . . . . Field measurements of process variables, local or remote, are received and displayed in digital form by the Metrototype information system.

169C Bailey Meter Co.

**Instruments** . . . . Combined technical skill and complete facilities for highly precise work in optics, mechanics and electronics. Details contained in literature.

TL164 \*Kollmorgen Optical Corp.

**Instruments, Nuclear** . . . . Complete line of nuclear instruments for research and industrial control include proportional counters, scalers, monitors, etc.

169D Hammer Electronics Co.

**Microtome** . . . . Design of new instrument described in 4 p. bulletin guarantees freedom from backlash needed for production of ultrathin serial sections.

169E William J. Hacker & Co.

**Pipeline Sampling** . . . . Precise, automatic methods of sampling directly from pipelines are described in new 8-page bulletin. Photos and schematic drawings.

169F Proportioneers, Inc.

**Pressure Reducer** . . . . Instead of spring mechanisms, regulator uses gas pressure for hand operation or solenoids for remote control. Inlet: to 4,500 psi. maximum.

169G Marotta Valve Corp.

**Purge Meter** . . . . New meter, featuring snap-in tube construction, removable end fittings, and a corrosion-resistant body is described in Spec Sheet 10A3135.

169H Fischer & Porter Co.

**Regulator** . . . . New No. 1003-B1 temperature regulator handles pressures up to 250 psi. Features new Teflon Chevron valve stem packing & new overrun assembly. Bulletin.

149 \*Robertshaw-Fulton Controls Co.

**Spectrofluorometer** . . . . 12 p. Bulletin 820, Supp. 1, describes two new types of spectrofluorometers. Gives full details on design, operation, performance.

169I Farrand Optical Co.

**Spectrophotometer** . . . . 4 p. bulletin describes KBr Model 137 Infracord spectrophotometer, new double-beam instruments designed for spectral region from 12.5 to 25.

169J Perkin-Elmer Corp.

**System, Weight-Rate** . . . . accurately controls flow rate of any liquid that will pass through a pipe. Controls flow rate by weight of liquid rather than by volume.

41 \*The Foxboro Company

\*From advertisement, this issue

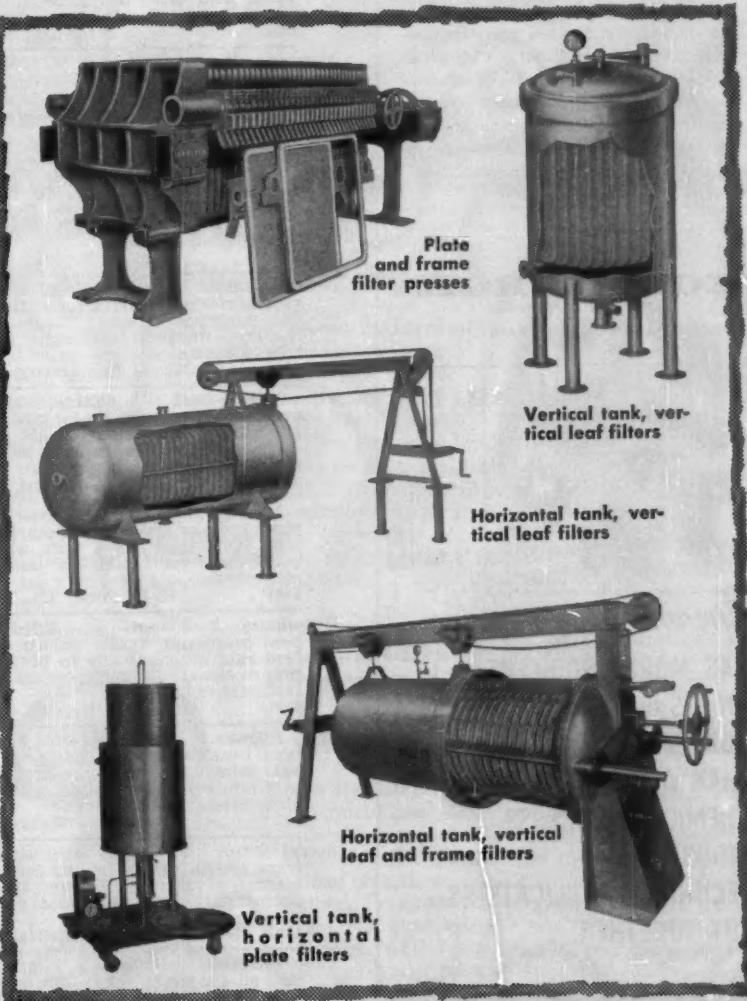
# We Sell Filtration NOT THE FILTER

At Shriver's we recommend the filter that's *right* for the specific processing conditions. This is done without prejudice or bias.

Of course, we design and manufacture an extensive line of pressure filters, suitable for a large majority of applications, but if our careful study of your filtration problem shows you need a vacuum filter or a pressure filter we do not manufacture, we tell you so frankly. Our aim: your satisfaction.

It's that simple, and has been paying off in customer goodwill for many years. We hope to continue meriting industry's confidence.

Literature on Shriver filtration equipment shown here will be gladly sent on request.



**T. SHRIVER & COMPANY, INC.**  
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FILTER PRESSES • VERTICAL LEAF FILTERS • FILTER MEDIA  
HORIZONTAL PLATE FILTERS • CONTINUOUS THICKENERS  
SLAB FORMERS • DIAPHRAGM PUMPS • ELECTROLYTIC CELLS



LITERATURE . . .

**Tubing** . . . Thinweld tubing, produced in sizes from  $\frac{1}{8}$  to 9 in. dia. with wall thicknesses from 0.002 to 0.049 in., is described in Bulletin 60. More than 80 metals.

171A Western Pneumatic Tube

**Tubular Products** . . . Illustrated booklet covers the various testing methods and inspections for manufacturer's line of alloy and stainless steel tubular products.

171B Babcock & Wilcox Co.

**Unions, Steel** . . . Available in  $\frac{1}{2}$ " to 3" pipe sizes. Booklet, "How to Tell a Good Union" outlines 16 points of forged steel unions for better service.

148 \*Clayton Mark & Co.

**Valve** . . . Folder "Design Factors in Stainless Steel Valves" offers complete details on the complete line. Feature extra-deep stuffing box, union bonnet joint, etc.

87 \*Cooper Alloy Corp.

**Valve Actuator** . . . Actuated electrically, the new Valvmatic converts hand-operated valves to motor operation. Piping is undisturbed on installation.

171C C. H. Wheeler Mfg. Co.

**Valve, Needle** . . . Improved with fabulous "Teflon" packing. Now enables the needle valve to stand up & work right under pressures up to 10,000 psi. Facts.

TL181 \*Marsh Instrument Co.

**Valve Slurry** . . . Information on a non-plugging, manually-operated valve for flow control of pulp stock and other slurries is available on request.

171D Fischer & Porter Co.

**Valves** . . . Complete information is available on Rotovalves, R-S Butterfly, and Ball valves. They handle many special applications & resist corrosion.

158 \*S. Morgan Smith

**Valves Automatic** . . . Twelve catalog pages describe 212 popular valves. Of these, 19 are entirely new. Convenient specification tables permit quick valve selection.

171E A. W. Cash Valve Mfg. Co.

**Valves, Diaphragm** . . . are available in a wide range of body, lining and diaphragm materials to meet different service conditions. Information available.

44 \*Grinnell Company, Inc.

**Valves, Gate** . . . in sizes, types and metals for all kinds of normal or unusual services. No wedging pressure during gate travel. Catalog No. 57 gives details.

144 \*Darling Valve & Mfg. Co.

**Valves, Jacketed** . . . keep slow moving corrosives flowing & are made in a variety of sizes & pressures. Furnished with inlet & outlet holes for heating with steam, etc.

30 \*Alloy Steel Products Co.

**Valves, Safety Relief** . . . features a durable, two-ply stainless steel sealing bellows which isolates contaminants, or viscous fluids. Cat. 1900.

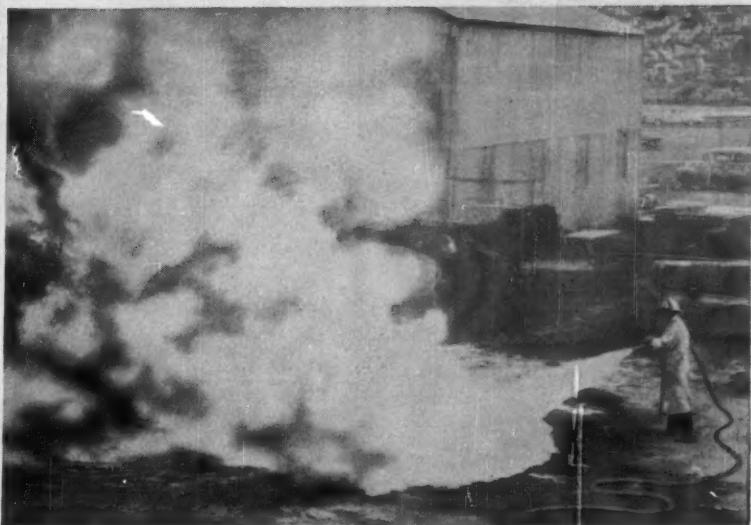
92 \*Manning, Maxwell & Moore, Inc.

**Tubing** . . . send for a copy of the new Trent 48-page tubing handbook. Gives details on applications, special features and uniformity of this tubing.

102 \*Trent Tube Co.

\*From advertisement, this issue

# NEW! FOR FIGHTING CHEMICAL FIRES!



## ONE-MAN DRY CHEMICAL KILLS MORE FIRE FASTER!

This new Kidde 200-pound pressurized unit has an extra 50 pounds of fire-smothering dry chemical, is designed for faster, easier operation. Its 40-foot stream gives more efficient extinguishing action, greater heat protection for the operator! No valves to unscrew, no wait for pressure, no pressure reducer to cause you trouble. Just remove safety pin, flip valve toggle, turn on nozzle lever. No conventional seal. Its exclusive Bridgeman seal holds pressure by using 450 psi to exert a *three-ton* sealing force.



## COMPLETELY NEW DRY CHEMICAL LINE GIVES FASTER, EASIER OPERATION!

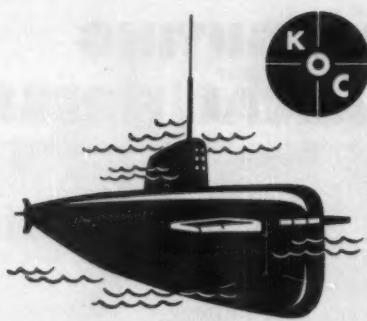
On the left, the new Kidde 20-pound dry chemical portable — completely new, completely better. The simplest, most efficient dry chemical portable on the market. Features include oversize aluminum handle for gloved-hand operation, perfect balance for faster action, simple one-two operation. Remove horn, pull trigger, and fire's out. Rugged, dustproof pressure gauge is recessed for protection. 10, 20- and 30-pound Kidde portables pressurized at 225-250 psi. Coming soon — new 2½- and 5-lb. models charged at 140-160 psi. Write today for information about this new Kidde line!

**Kidde**



Walter Kidde & Company, Inc.  
1228 Main St., Belleville 9, N.J.

Walter Kidde & Company of Canada Ltd.  
Montreal — Toronto — Vancouver



## eyes for the silent service

During her history-making voyage under the Polar icecap, the *Nutilus*, like all other submarines in the atomic fleet, carried two periscopes designed and manufactured by Kollmorgen. The high degree of optical and mechanical skill required to produce these periscopes can be drawn on to solve your remote viewing and inspection problems. For literature, write Department 14D.

**KOLLMORGEN**  
optical corporation  
NORTHAMPTON, MASSACHUSETTS



## expecting an order?

You'll get it quicker if your postal zone number is on the order blanks, return envelopes, letterheads.

The Post Office has divided 106 cities into postal delivery zones to speed mail delivery. Be sure to include zone number when writing to these cities; be sure to include *your* zone number in *your* return address — after the city, before the state.

## LITERATURE . . .

### Process Equipment

**Blenders** . . . . Twin-Shell liquid-solids blender easily & thoroughly disperses as little as 0.5% by weight of any liquid into dry solids. A type for every process.  
52-53 \*Patterson-Kelley Co.

**Blenders** . . . . Rotary Blenders start 4-way blending while charging, continue it during discharge, producing even blends of dry & semi dry materials. Bulletin 080B.  
R170 \*Sturtevant Mill Co.

**Centrifugals** . . . . Reineveld automatic centrifuges used for dewatering & washing of crystalline solids & for separation & classification of fine amorphous slurries. Bul. 356.  
T182 \*Heyl & Patterson, Inc.

**Cone Crushers** . . . . Bulletin 247 describes the various types of cone crushers used in primary & secondary fine reduction crushing of ores & minerals.  
139b \*Nordberg Mfg. Co.

**Cooling Towers** . . . . Martreat Bulletin MT-58 pinpoints the organisms that destroy effectiveness of your tower & prescribes the treatment & its application techniques.  
23 \*The Marley Co.

**Deminerilizer, Water** . . . . Model TM-6, two-bed deminerilizer at flow rate of 2500 G.P.H. Available in mixed-bed, single-bed, two-bed, & four-bed models. Cat. 127A.  
103a \*Barnstead Still & Sterilizer Co.

**Dryer Blender** . . . . The new glassed-steel conical dryer blender gives versatility of application—impregnation, concentration, reaction, or coating.  
172A \*The Pfaudler Co.

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**Ejectors, Steam Jet** . . . . A wide range of single-stage & multistage types for maintaining low absolute pressures in refineries, chemical plants, etc.  
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Mountaineer averages better than 75% yield, several percentage points higher than older installations. And the coke is more uniform in density.

Mountaineer gains these advantages through close control of combustion. A single gas-fed burner in hood at discharge end of kiln generates a temperature of about 2,500 F. Flame configuration, primary and secondary air flows are all controlled carefully; seals cut leakage of unwanted air.

This close control of combustion allows some burning of cracked gases from coke bed. Yet, it prevents unwanted combustion of carbon which reduces yields in most coke calcining. Too, it produces uniform density in finished product, a direct result of uniform temperature.

Kiln is 180 ft. long and 10.5 ft. in dia. Rotating at about 1 rpm., it retains coke approximately 100 min.



KENNEDY equipment is behind the high performance record of this new plant:

- The 180' long kiln with its bronze sleeved, self-aligning bearings, 3-tire supports and drive assembly;
- Special feed and discharge air seals which reduce air leakage and improve combustion control;
- The kiln firing hood with its extra large access doors for maintenance;
- The air cooled nose ring assembly, specially designed by KENNEDY for coke-calcining.

When you are in need of kilns—for lime, calcined coke, dead burned dolomite, cement by wet or dry process, nodulizing and agglomerating or drying—consult KENNEDY. You can be assured of quality equipment that delivers high, long-lasting performance.

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4 \*Bird Machine Co.

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174B Sonic Engineering Corp.

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174C Tri-Homo Corp.

**Mills, Grinding** . . . built to meet specified conditions for wet or dry grinding in processes where friable material must be comminuted to fine sizes. Bul. 232.  
139a \*Nordberg Mfg. Co.

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176a \*Denver Equipment Co.

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151 \*The J. H. Day Co.

**Mixers** . . . Booklet, "Milling In The Chemical Process Industry", is available. Mix-Muller method of blending accomplishes dispersion without segregation.  
104 \*National Engineering Co.

**Mixers, Portable** . . . Especially designed for small batch processes. Eastern's improved line is included in the revised portable bulletin 530-B.  
153 \*Eastern Industries, Inc.

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174D Hemeon Associates

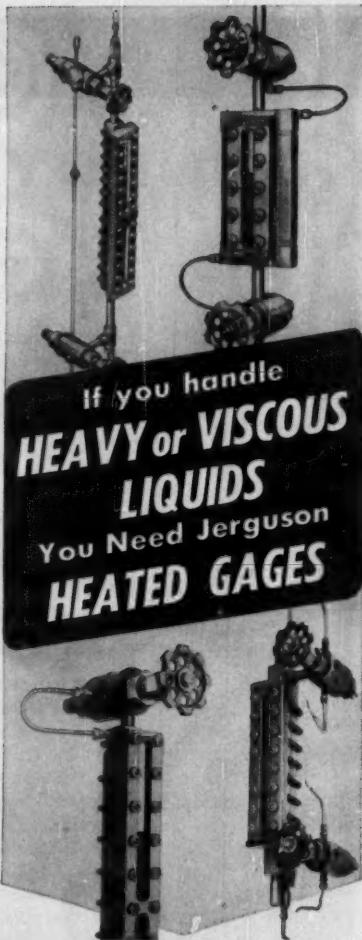
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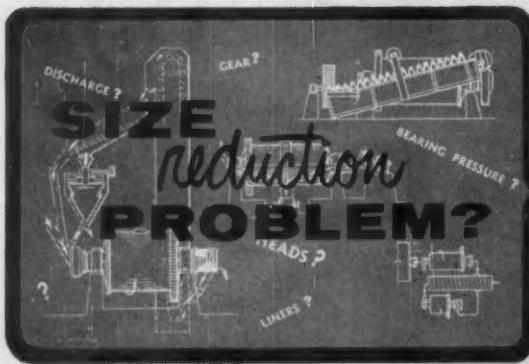
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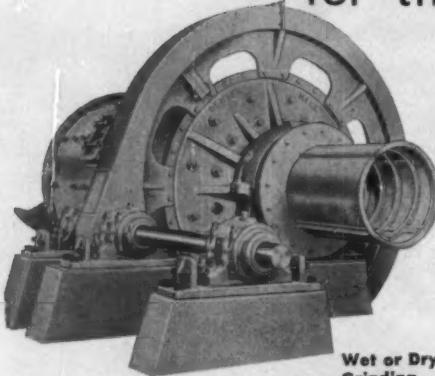
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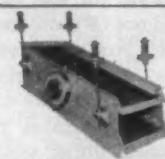
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18-19	47-48	69	80C	102	142b	150A	156	164D	171G	169F	171B	176B	181I	183d
20-21	50	71	81	103a	142c	150B	157	164E	167	169G	171C	176C	181I	183e
22	52-53	73	82A	103b	142d	151	158	164F	167A	169H	171D	176D	181I	190
23	55	75	82B	104	142e	151A	159	164G	168A	169I	171E	176E	182A	191
25	57	76A	82C	106	142f	152	160	164H	167B	169J	172A	176a	182B	191
26	59	76B	82D	129	142g	152A	161	164I	167D	169K	172B	176b	182C	192
27	61	76C	83	131a	142h	152B	162	164J	168A	169L	172C	176c	182D	192
28	63	76D	84	131b	142i	153	162A	164K	168B	169m	173	176d	182E	193
29	65a	77a	85	131c	142j	153A	162B	164L	168C	169n	174A	176e	182F	194
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87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	107	108	109
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6-7	39	65f	78C	91	138	147	153F	163	165D	168H	170D	174F	176g	182J						
8-9	40a	65g	78D	92	139a	148	153G	163A	165E	168I	170E	174G	176h	182K						
10-11	40b	65h	78E	93	139b	148A	154	163B	165F	169A	170F	174H	180A	182L						
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20-21	50	71	81	103a	142c	150B	157	164E	167	169G	171C	176C	181I	183e						
22	52-53	73	82A	103b	142d	151	158	164F	167A	169H	171D	176D	181I	190						
23	55	75	82B	104	142e	151A	159	164G	168A	169I	171E	176E	182A	191						
25	57	76A	82C	106	142f	152	160	164H	167B	169J	172A	176a	182B	191						
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28	63	76D	84	131b	142i	153	162A	164K	168B	169m	173	176d	182E	193						
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87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	107	108	109
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142f—Vacuum Pan  
142g—Style CW—2/3 Jacketed  
142h—Pulp Tank  
142i—Storage Tank  
142j—Quick Cooling Pan  
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Presses  
169b—Vertical Tank, Vertical Leaf Filters  
169c—Horizontal Tank, Vertical Leaf Filters  
169d—Horizontal Tank, Vertical Leaf & Frame Filters  
169e—Vertical Tank, Horizontal Plate Filters  
176a—Steel Head Mills  
176b—Jaw Crushers  
176c—SRL Pumps  
176d—Agitators & Mixers  
176e—Screens  
176f—Agitator-type Disc Filters  
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Solids-Liquid Separation—Basic know-how (\$1) . . . . .	62

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Conveyor & Elevators—Solving bulk moving (50¢) . . . . .	46
Heat Exchanger Design—Timely shortcuts (75¢) . . . . .	52
Instruments—"Hardware" section: Report No. 95 (50¢) . . . . .	96
Mechanical Seals—How to select and use them (50¢) . . . . .	83
Piping—Roundup of processes pipe, valves, fittings (75¢) . . . . .	40
Pumps—How to pick the one you need for your job (50¢) . . . . .	21
Pump Seals—How to select the best (50¢) . . . . .	92
Solids Feeders—How to lick feeding troubles (50¢) . . . . .	28
Strain Gages—How to use in chemical plants (50¢) . . . . .	36

#### • Materials of Construction

High-Temperature Materials—Inorganic, nonmetallic (75¢) . . . . .	120
Industrial Plastics—How and where to use them (50¢) . . . . .	35
Lead Installations—Best designs for many uses (50¢) . . . . .	79
Nonmetallic Inorganics—For severe conditions (50¢) . . . . .	125
Protective Linings—For process equipment (\$1) . . . . .	88

#### • Processes

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Bio-oxidation—Theory, design, practice (50¢) . . . . .	68
Extractive Metallurgy—Via chemical engineering (50¢) . . . . .	111
Fermentation—Its chemical technology (50¢) . . . . .	74
Fluidized Solids—Theory & Techniques (50¢) . . . . .	33
Manufactured Gas—To supplement natural gas (50¢) . . . . .	115
Moving Bed Processes—Application plus theory (75¢) . . . . .	64
Odor Control—How to be a good neighbor (50¢) . . . . .	90
Petrochemical Processes—A review of processes (50¢) . . . . .	26

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Cost Index—One-year bibliographic index (35¢) . . . . .	65
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Modernization—Plan '59 for profits (75¢) . . . . .	128
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Plants & Processes—From 1956 Inventory Issue (75¢) . . . . .	84
Plants & Processes—1957-58 (Eighth) inventory (75¢) . . . . .	118
Professional Registration—For PE-minded ChE's (50¢) . . . . .	85
Rockets & Missiles—Airborne reactor problems (75¢) . . . . .	119
Statistics—How to use data effectively (75¢) . . . . .	73
Water Conservation—A factor to consider (50¢) . . . . .	105
Water Pollution Control—How to cope with it (50¢) . . . . .	122

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Thermodynamic Principles (50¢) . . . . .	42
Compression & Expansion (50¢) . . . . .	45
Chemical Equilibrium (50¢) . . . . .	49
Homogenous Kinetics (50¢) . . . . .	57
Catalytic Kinetics (50¢) . . . . .	61
Interpreting Kinetics (50¢) . . . . .	66
Simple Reactor Design (50¢) . . . . .	72
Complex Reactor Design (50¢) . . . . .	75
Catalytic Reactor Design (50¢) . . . . .	81
Reactor Design Problems (50¢) . . . . .	87
Physical Equilibrium I (50¢) . . . . .	90
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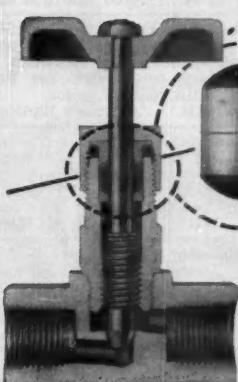
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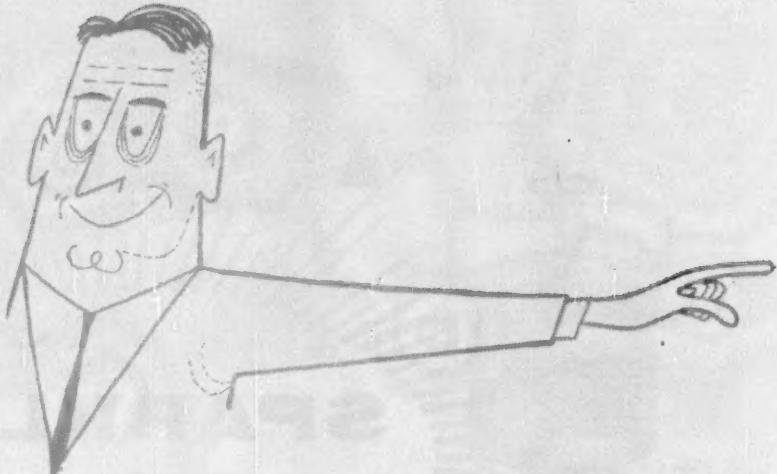
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(Continued on following page)

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E	30" Fletcher Stainless Susp. Cent. M.D.
N	40" Fletcher Steel Susp. Cent. M.D.
D	750 gal. jktd. Steel Reactor 300 PSI
F	50 gal. jktd. Stainless Reactor 50 PSI
O	Sweetland #10 Filter 36 SS Leaves
R	4' Stainless Industrial 14 leaf Filter
C	#6669 Raymond 6 roll Hi-Side Mill
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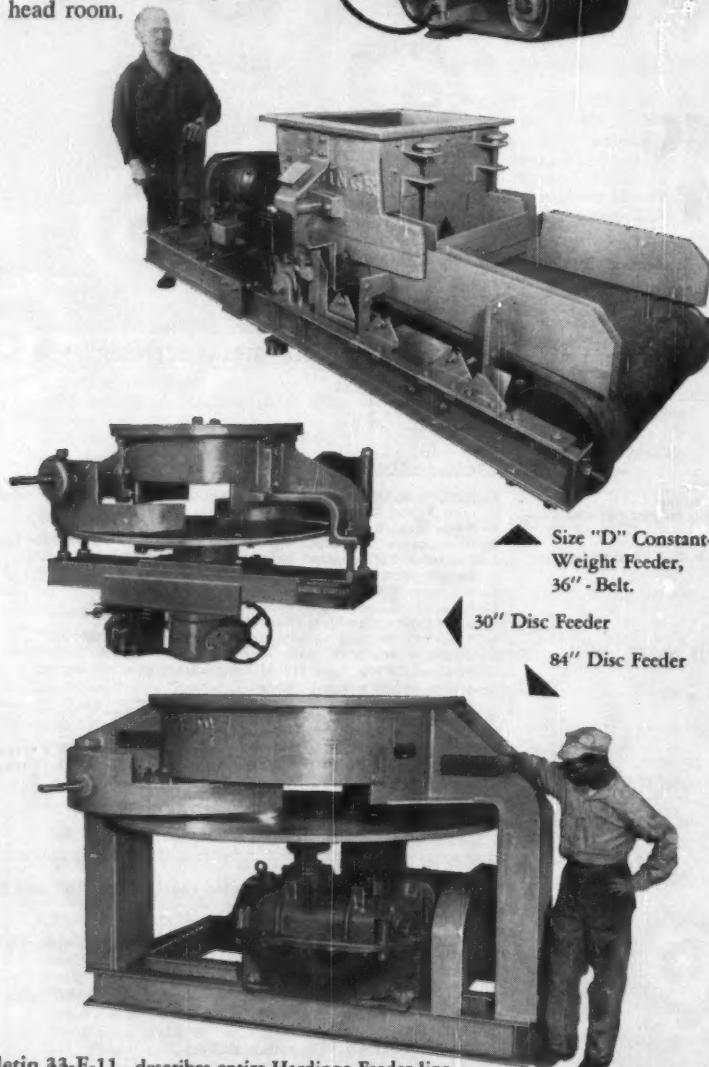
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**INDEX OF**

Allen Bradley Co.	50
Allis-Chalmers Mfg. Co.	
General Machinery Div.	97
Alloy Steel Products Corp.	30
American Brass Co.	1
Metal Hose Div.	136
American Flange & Mfg. Co.	71
American Meter Co.	
Pump Division	138
Ames Iron Works	93
Antara Chemicals, Div. of	
General Aniline & Film Corp.	86
Autoclave Engineers, Inc.	85
Avondale Marine Ways, Inc.	145

Baker & Adamson Products,	
General Chemical Div. of Allied Chemical Corp.	55
Barber-Colman Co.	165
Barnstead Still & Sterilizer Co.	103
Beach Russ Co.	166
Beckman Instruments, Inc.	27
Bethlehem Steel Co.	46
Bird Machine Co.	4
Bristol Co.	84
Buffalo Pumps	26

Camco Fittings Co.	140
Carborundum Co.	39
Carrier Corp.	83
Celanese Corp. of America	75
Chemical & Power Products, Inc.	181
Chicago Bridge & Iron Corp.	
Claraage Fan Co.	69
Cleaver Brooks Co.	12
Cochrane Corp.	45
Continental Can Co.	154
Cooper Alloy Corp.	87
Crouse-Hinds Co.	33-38

Darling Valve & Mfg. Co.	144
Day Co., J. H.	151
Dean Products, Inc.	
Dean Thermo-Panel Coil Div.	164
DeLaval Separator Co.	6-7
Denver Equipment Co.	65, 176
Dow Corning Corp.	159
Downington Iron Works	13
Duriron Company, Inc., The	131

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## ADVERTISERS

Eastern Industries, Inc.	153
Eaton-Dikeman Co.	164
Electric Machinery Mfg. Co.	67
Elliott Co.	167
Emery Co., A. H.	31
Englehard Industries, Inc.	77
Enjay Company, Inc.	59

Falls Industries, Inc.	161
Forge & Fittings Div., H. K. Porter Company, Inc.	162
Foxboro Co.	41

General Electric Co.	16-17
Goodrich Industrial Products Co., B. F.	194
Goslin-Birmingham Mfg. Co.	150
Graver Tank & Mfg. Co.	175
Grinnell Company, Inc.	44

Hammond Iron Works	155
Hardinge Co.	190
Harshaw Chemical Co., The	88
Heyl & Patterson Inc.	182
Hills McCanna Co.	81

Illinois Water Treatment Co.	192
International Engineering Corp.	180
International Nickel Co.	141

Jerguson Gage & Valve Co.	174
Johns Manville Corp. Insulation	14-15
Jones & Laughlin Steel Corp.	20-21

Kennedy Van Saun Mfg. & Engrg. Co.	173
Kidde & Co., Walter	171
Kollmorgen Optical Corp.	164, 166 168, 170, 172, 174

Lapp Insulator Co. (Pulsafeeder)	79
Lee Metal Products Co.	142
Linde Co., Div. of	171
Union Carbide & Carbon Corp.	129
Lummus Co.	28

Manning, Maxwell & Moore, Inc.	22
Manzel Division of Houdaille Industries, Inc.	146
Mark & Co., Clayton	148
Marley Co.	23
Marsh Instrument Co.	181
Mine Safety Appliances Co.	25
Mixing Equipment Co.	4th Cover

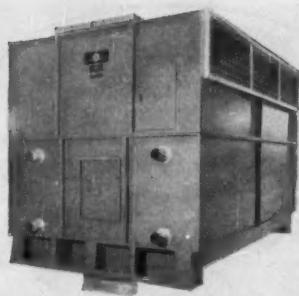
National Airoil Burner Co.	163
National Engineering Co.	104
Newark Wire Cloth Co.	155
Niagara Blower Co.	191
Nichols Engineering & Research Corp.	29
Nordberg Mfg. Co.	139

Pangborn Corp.	57
Patterson-Kelley Co.	52-53
Peerless Pump Div., Food Ma- chinery & Chemical Corp.	193
Petro-Chem Development Co.	91
Pitt-Consol Chemical Co.	156
Pittsburgh Lectrodryer Div. of McGraw-Edison Co.	61
Prater Pulverizer Co.	182

Quaker Oats Co., Chemical Div.	73
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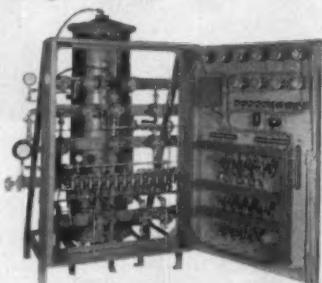
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ADVERTISERS . . .

Raybestos-Manhattan  
 Manhattan Rubber Div. .... 143  
 R & I E Division  
 I-T-E Circuit Breaker Co. .... 94  
 Robertshaw Fulton Controls Co.  
 Fulton Syphon Division. .... 149  
 Rockwood Sprinkler Co. .... 18-19

Saran Lined Pipe Co. .... 32  
 Sargent Sons Corp., C. G. .... 160  
 Sellers Injector Co. .... 137  
 Sel Rex Corp. .... 181  
 Shell Chemical Corp. .... 2nd Cover  
 Shriner & Co. T. .... 169  
 Sigamotor, Inc. .... 168  
 S. Morgan Smith Co. .... 158  
 Southwestern Supply & Machine  
 Works .... 168  
 Sparkler Mfg. Co. .... 183  
 Spray Engineering Co. .... 152  
 Sprout Waldron & Co. .... 40  
 Square D Company .... 43  
 Standard Oil Co. (Indiana) .... 92  
 Stokes Corp., F. J. .... 42  
 Stone & Webster Engrg. Corp. .... 95  
 Sturtevant Mill Co. .... 170  
 Sun Shipbuilding & Dry Dock Co. .... 24

Taber Pump Co. .... 172  
 Tote Systems .... 96  
 Trent Tube Co. .... 102  
 Tri-Sure Products, Limited .... 71

Union Iron Works .... 157  
 U. S. Rubber Company .... 133

Vogt Machine Co., Henry .... 106  
 Vulcan-Cincinnati, Inc. .... 8-9

Walworth Company .... 147  
 Waukesha Foundry Co. .... 135  
 Wisconsin Protective Coating Co. .... 192  
 Wolverine Tube, Div. of  
 Calumet & Hecla, Inc. .... 89-90  
 Worthington Corp. .... 10-11  
 Wyandotte Chemicals Corp.  
 Michigan Alkali Div. .... 47-48

Zallea Bros. .... 63  
 Zink Co., John .... 191

PROFESSIONAL SERVICES .... 184  
 CLASSIFIED ADVERTISING  
 F. J. Eberle, Business Mgr.

EMPLOYMENT  
 OPPORTUNITIES .... 185, 186  
 EQUIPMENT  
 (Used or Surplus New)  
 For Sale. .... 185-189

ADVERTISERS INDEX

Aaron Equipment Co., Div. of Areco  
 Inc. .... 188  
 American Air Compressor Corp. .... 187  
 Brill Equipment Company .... 185-187  
 Bristol Company .... 185  
 El Paso Natural Gas Company .... 185  
 Equipment Clearing House Inc. .... 186  
 Erman-Hornell, Div. Luria Steel &  
 Trading Corp. .... 186  
 Gelb & Sons, Inc., R. .... 189  
 Greenpoint Pipe Co., Inc. .... 187  
 Heat & Power Company, Inc. .... 186  
 Lawler Company .... 188  
 Loeb Equipment Supply Co. .... 186  
 Machinery & Equipment Co., Inc. .... 186  
 187-188  
 Monarch Personnel .... 185  
 Perry Equipment Corp. .... 188  
 Process Equipment Sales Co. .... 186  
 Rogers & Wright Company .... 186  
 Stein Equipment Company .... 186  
 Sussman, Inc., Louis .... 187  
 Union Standard Equipment Co. .... 186

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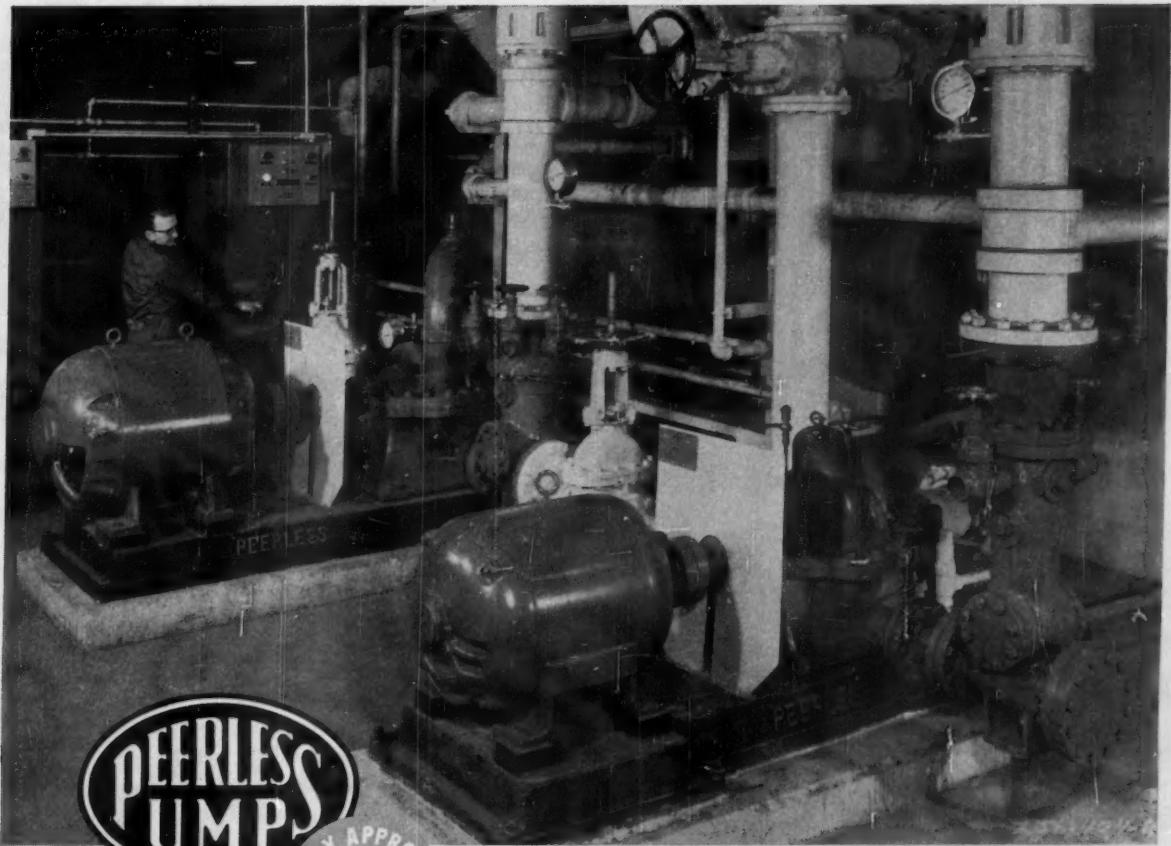
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**B.F. Goodrich**

**acid hose**

**handles highly  
corrosive acids**

B.F.GOODRICH offers "Commander" acid hose, a new hose that can handle the highly corrosive acids and chemicals that quickly eat holes in ordinary acid hose.

For years engineers have been searching for a hose to carry strong oxidizing acids like concentrated sulphuric acid, nitric acid and chromic acid. A new rubber compound that resists these acids has now been developed especially for acid hose. This new rubber, used in the thick tube of B.F.Goodrich Commander acid hose, makes it possible for the hose to last many months or even years in service where ordinary

acid hose lasts only a few weeks. This means less downtime, lower operating costs, and reduces the hazards of handling dangerous acids.

A special rubber compound is also used in the tough, smooth cover of this B.F.Goodrich hose. It gives the hose high resistance to acids, salts, alkalis, abrasion, weather and just about everything else that ruins regular hose.

The new hose comes in two constructions: with or without wire reinforcement. The wire-reinforced hose can be used for both suction and discharge service. It has a heavy spiral

steel wire embedded in the rubber that prevents collapse under full vacuum, increases crush resistance. The hose without wire reinforcement is for pinch-valve service, and can also be used to handle acids which form crust on tube that must be broken off by flexing or pounding hose.

Your B.F.Goodrich distributor has full information on the acid hose described here. And as a factory-trained specialist in rubber he can answer all your questions about all the rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Company, Dept. M-482, Akron 18, Ohio.*

**B.F.Goodrich acid hose**

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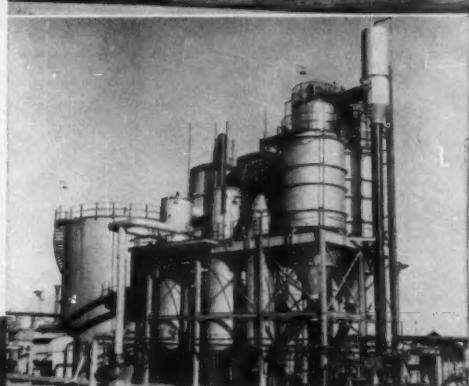
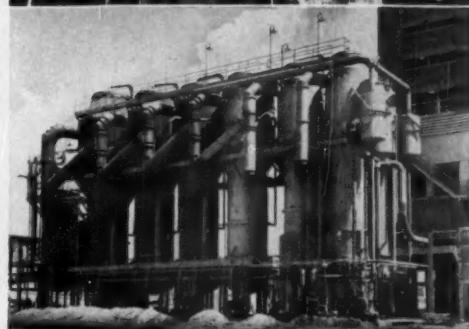
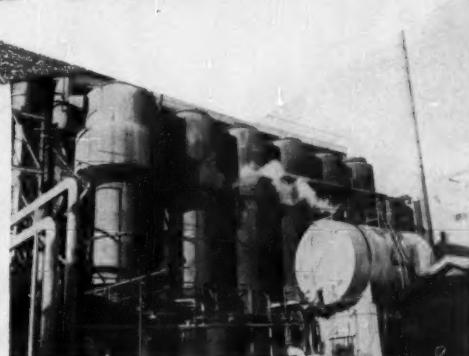
CB&I—long the leader in the fabrication of vessels, field erection, X-ray, stress-relieving and welding—now supplements its organization with a staff of competent, experienced chemical engineers who are capable of designing heat transfer and other process equipment to suit your needs.

Whether you are contemplating a new plant, a plant expansion, or replacement of existing equipment—it will pay you to investigate how CB&I's coordinated services can provide equipment that is designed, fabricated, erected, put into operation and guaranteed under a single responsibility.

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C45C



## Cost-cutting approach saves \$6,000 on fluid mixing

*An idea from your LIGHTNIN Mixer representative's briefcase*

Here's a fluid mixing idea that has already saved a company \$6000 on equipment, and is saving many more dollars on operating expense.

In this plant, heavy clay-and-water slurry is mixed in tall tanks. But this operation posed a big maintenance problem, because the long vertical mixer shaft in each tank had to be steadied by a bearing in the tank's bottom. Gritty clay kept getting into this bearing and grinding it to pieces in a few weeks.

Then production had to stop while maintenance men hoisted out the heavy shaft and installed a new bearing. The bearings didn't cost much, but the tab for replacing them was ruinous.

Finally a LIGHTNIN Mixer representative explained how this company could easily mix uniform clay

suspensions in its tall tanks—with a side entering LIGHTNIN Mixer like the one you see here.

Now there's no maintenance headache, because no steady bearing is needed; so production keeps moving without costly stoppages.

Also, it costs *\$6000 less* to install one of these LIGHTNINS than it would cost to replace the older mixers, mainly because no elaborate bracing is required on top of the tank. And this company reports its clay suspensions are much more uniform than before.

### What this man can do for you

This is just a sample of the cost-cutting approach to mixing that you get from your LIGHTNIN representative.

He can bring you long-term savings

on fluid mixing better than anyone else—because that's his job, and he's an expert at it.

He can help you avoid engineering headaches, too, because his recommendations are based on unique MIXCO pilot-run data guaranteed accurate.

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